HIP AND GROIN INJURIES

prevention & treatment

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The research newsletter on stamina, strength and fitness

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From the editor

Athletes, especially those who take part in dynamic sports (e.g. football, gymnastics, triple jump) will know how frustrating a hip or groin injury can be to shift. Apart from the frustration of re-occurrence if the root cause is not treated, there are a host of hamstrings and lower back injuries that are likely to follow if fundamental changes are not taken. This report offers specific and practical resources (injury tests, fitness tests, musculature consequences) to address the whole problem and attain long term balance and athletic function.

To give you a taster, the report kicks off with Scott Smith discussing the movement pathology of the hips and likely consequences that particular posture types will have on the associated muscles of the hip. It includes a couple of practical tables relating to muscle length, types and simple exercises that can be introduced to improve muscle imbalances.

In a two part groin special, Chris Mallac discusses the deep lying psoas muscle and how to effectively self treat this troublesome hip flexor. The psoas muscle can often be ignored by athletes, coaches and therapists. Unlike other deep lying muscles, like the piriformis, stretching psoas and trying to locate psoas with your fingers is not easy. When you look at where it lies in relation to the pelvis and the role it has to play, you'll understand that in both hip, groin and lower back injuries quality and feel of psoas is paramount.

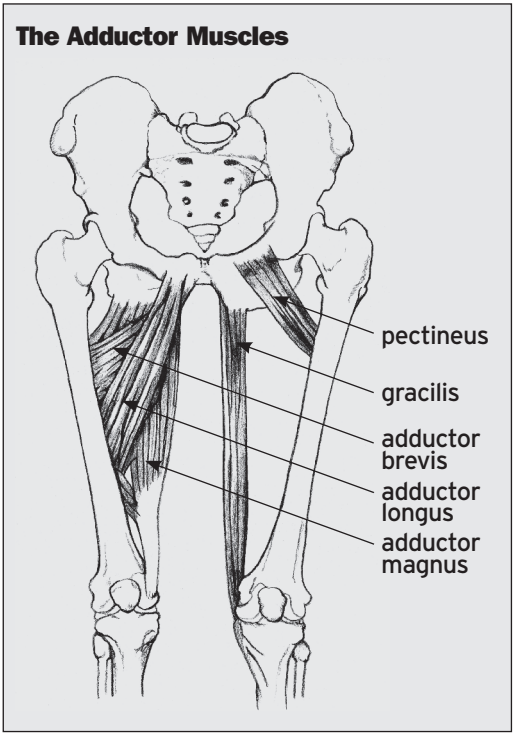
Instability of the pelvis also has many injury consequences, including groin, hip and lower back. Important muscles that play a vital role in improving stability are gluteus medius, transverse abdominis and oblique abdominis. Chris Mallac teams up with Dirk Spits to discuss tests to check for gluteus medius instability and again includes a useful chart to demonstrate key points to look for and clearly laid out rehabilitation exercises for increased strength. Another program of exercises for gluteus medius is provided by Raphael Brandon that is sure to prove a useful reference tool for both athletes and coaches.

Finally, Ulrik Larsen includes a first hand case study of a rugby player with groin problems. It is an interesting point that (among

other factors) the player had poor pelvic stability due to weak transverse and oblique abdominis. This was hidden very well by high quality musculature and a 6 pack. It is a lesson not to let initial looks deceive. Due to this, the final element of the report focuses on core exercises purely for transverse and oblique abdominis, so there is no mistaking which are the correct core muscles for pelvic stability.

In essence, the assessment, strength and fitness tests are all vital and there are many charts and programs that at your finger tips, whether pitch side, track side or in the clinic. I know I'll be keeping this report close at hand, I hope you find it as useful as I do.

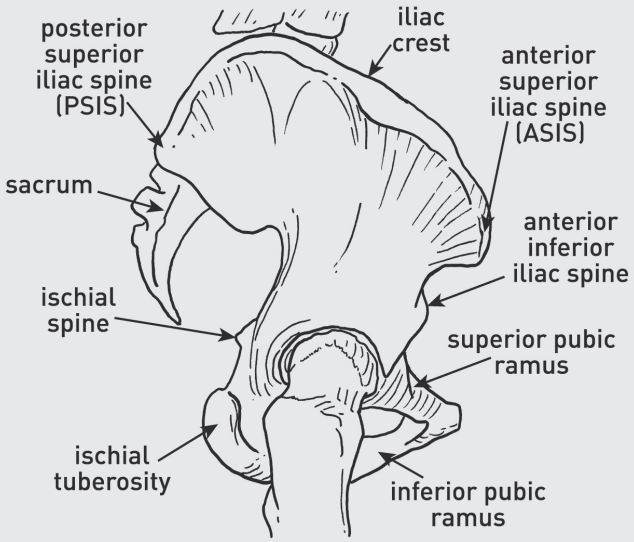
Lotty Skinner



Information on Adductor Muscles

The adductors comprise of 5 muscles that can be divided into short adductors (pectineus, adductor brevis and longus) and long adductors (adductor magnus and gracilis). The adductors assist in hip flexion and help stabilise the legs in running. Sports that heavily use these muscles are, hurdling, football (side passes, curling the ball), and tennis (general manoeuvring on court, side steps or side shifting). These muscles are generally much tighter in men than in women. Groin pulls are often related to fatigue (initiated by reasons that will be discussed in the report) and improper stretching of adductor longus.

The Pelvic Girdle



Information on Pelvic Girdle

The pelvic girdle attaches the lower limbs to the axial skeleton and transmits the weight of the upper body to the lower body limbs. The pelvic girdle is formed by a pair of hip bones (or coxal bones), each join with its partner anteriorly (at the front) and with the sacrum posteriorly (at the back). The deep basin like structure formed by the hip bones, together with the sacrum and the coccyx is called the bony pelvis.

Each large irregularly shaped hip bone (or coxal bone) consists of three seperate bones during childhood: the ilium, ishium and pubis. In adulthood these bones are firmly fused and their boundaries are indistingushable. Their names are retained however, to refer to different regions of the composed hip bone. At the point of fusion of the ilium, ischium and pubis is a deep hemispherical socket called the acetabulum on the lateral surface of the pelvis. The acetabulum receives the head of the femur (thigh bone) at what is known as the hip joint.

A firm hold on the hips

Scott Smith ***explains the concept of a 'rotator cuff' of the hip and why the right degree of stability matters***

Stand alone hip problems are in the majority straight forward, but it is important to remember that the hip joint can also be just one part of a bigger puzzle in a complex lower limb problem, as its functioning has such important consequences both for the lumbo-sacral region and for the knee and ankle.

The hip joint is usually very mobile, having to withstand both direct loading stresses and large rotational forces with weight-bearing activities. It is especially vulnerable to injury in sports that involve pivoting or twisting movements, such as soccer, Australian Rules football, tennis and golf.

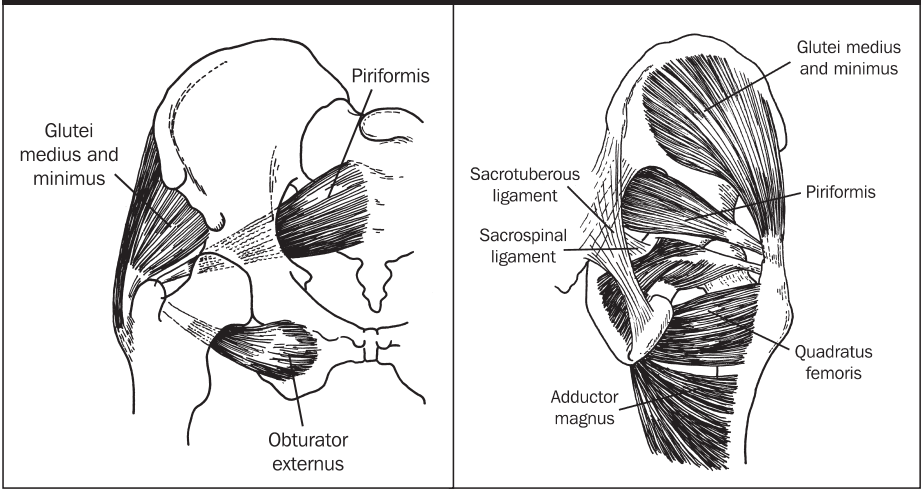
In golf the hip is especially exposed to high-velocity internal rotation on the downswing, requiring a great deal of eccentric gluteal muscle control. Paradoxically, the increased risk of hip injury is a relatively recent hazard for golfers, arising from the greater rotation favoured by the modern golf swing – an adaptation to technique brought about to reduce the incidence of low-back injury among golfers.

In Australian Rules football the hip is subjected to repeated adduction and flexion/extension forces. This again requires great control throughout the gluteal muscles and the adductor muscle complex. It is these rotational and shear forces that cause injuries such as groin strains and osteitis pubis.

Tennis involves a combination of the above movement patterns, such as when performing ground strokes or when lunging forward and stretching for a drop shot.

Because the muscles around the hip joint attach directly on to the joint capsule, they have a large influence on the range of movement, as summarised in Tables 1 and 2.

The 'rotator cuff' muscles of the hip



Rotational forces place tremendous strain on the ligamentous and muscular structures designed to protect the joint. The failure to adequately control these forces can lead to damage such as labral tears and femoral neck stress fractures[1]. Below, we consider two kinds of movement pathologies and self-help exercises to help correct them.

The first type of problem – and the easier to treat – is when the hip joint has restricted motion. This can produce local hip pain or cause dysfunction in the lumbar spine/sacroiliac joint or the knee, as a result of these structures attempting to compensate for the lack of movement at the hip joint.

The second type of problem is where the hip joint has an increased amount of movement arising from a lack of control of the femoral head (top of the thigh bone) in the hip socket; you will often feel or hear clicking or clunking, or a feeling of weakness in the region. A failure to correct this lack of control can lead to joint damage and subsequent long-term restriction of movement.

If only it were so simple that we could split the problem into one or other type of dysfunction. However in reality it will often be a combination of the two.

Table 1: Muscles attaching on to the hip joint

Muscle	Capsular attachment
Rectus femoris and tensor fascia lata	Anterior capsule
Gluteus minimus	Superior capsule
Pectineus	Inferior capsule
Deep external rotators	Posterior capsule

Table 2: Movements at the hip and effect on the femoral head

Hip movement	Femoral head shift of position
External rotation/extension	Forwards
Internal rotation/flexion	Backwards
Abduction	Downwards
Adduction	Upwards

1. Restricted movement

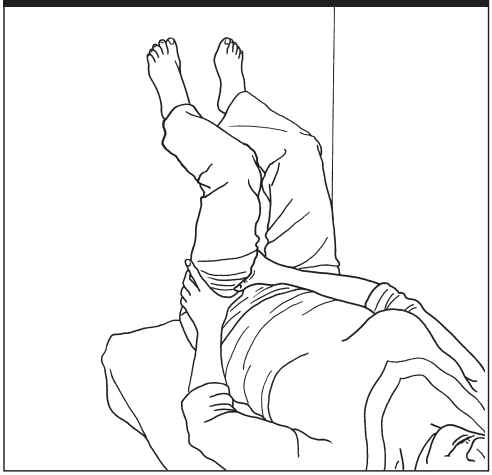
Postural type can exert a significant influence on the length of the muscles around the pelvis and thus the degree of normal hip movement. There are two classic postural models that can cause restrictions to hip movement. So, for example, in the lordotic-kyphotic postural type (*see fig 1, right*), rectus femoris and the iliotibial band (ITB) will be shortened, reducing the range of hip extension. This is because these muscles attach directly on to the anterior capsule of the hip joint. The likely changes to muscle length are summarised in Table 3 overleaf.

If the deep external rotators have restricted length, then you would expect reduced posterior movement of the femoral head and thus reduced internal rotation/flexion. If there is not adequate range of hip flexion/internal rotation then compensations in other areas,

Figure 1: Lordotic-kyphotic posture, alignment characteristics

- marked anterior pelvic tilt
- lumbar lordosis increased in depth
- thoracic kyphosis increased in depth
- relative hip flexion

Figure 2: Femoral glide



such as the lumbar spine would undoubtedly take place.

A common factor is reduced posterior movement of the femur, thus reducing the range of flexion/internal rotation. This often goes along with increased medial movement and range of hip abduction, which leads to overstretching injuries in the groin. The groin muscles themselves are normally long and weak, and prone to spasm or appearing to shorten. These are common factors in conditions such as osteitis pubis.

The following two techniques help improve hip flexion and adduction.

1. Femoral glide (*see fig 2*)**:** Place feet against the wall, hips and knees at 90 degrees, and hold your hands around the top of the femur. Then apply a movement of the femur, pushing towards the wall, holding for 30 seconds and repeating four times. This should be performed twice daily.

Table 3: Lordotic-kyphotic posture, predictable muscle length changes

Muscle group	Likely change
Abdominals	
● obliques	Long and inhibited
● rectus abdominis	Long
Back extensors	
● longissimus and iliocostalis lumborum	Short and overactive
Hip flexors	
● tensor fascia lata (and ITB)	Short and overactive
● rectus femoris	Short and overactive
● iliopsoas	? Short / ? variable
Hip extensors	
● gluteus	Variable
● hamstrings	Variable

Table 4: Swayback posture, predictable muscle length changes

Muscle group	Likely change
Abdominals	
● obliques	Long or inhibited
● rectus abdominis	Overactive or short
Back extensors	
● superficial multifidus and spinalis	Long and inhibited
Hip flexors	
● tensor fascia lata (and ITB)	Short and overactive
● rectus femoris	Variable
● iliopsoas	Long and inhibited
Hip extensors	
● gluteus	Inhibited
● hamstrings	Short and overactive

Source: Kendall FP, Mcreary EK, Province PG, 1993. Muscle Testing and Function, Williams & Wilkins

2. Ball squeeze: Sit with legs flexed to 90 degrees and squeeze a small ball between the knees, holding for 30 secs. Repeat four times daily.

2. Lack of stability control

Poor hip stability is evident when the hip demonstrates an increased amount of movement and thus lack of control of the gliding of the femoral head in the acetabulum (hip socket). This commonly occurs when the femoral head is sliding too far forward. For example, a person with a swayback posture (*see figure 3, overleaf*) stands in posterior tilt/hip extension and then just hang on the ligaments and muscles anteriorly. As these muscles fatigue, there is increased strain on the underlying hip capsule.

People with this type of problem may have clicking/clunking of the hip, especially

Figure 3: Swayback posture, alignment characteristics

- forward sway of the pelvis
- neutral to posterior pelvic tilt
- thoracic kyphosis increased in length
- lumbar lordosis reduced in length
- relative hip extension

as they go from sitting to standing, or when (as in ballet turnout) they externally rotate the hip.

People in this category, need to improve their muscular control. If they also have a reduced range of hip movement in the opposing direction as a result of tight muscles, it will be helpful to try to increase this at the same time.

It is the local stability muscles that help control the shear forces produced by the forward movement of the femoral head. These are tonic or holding muscles which do not fatigue easily and which provide feedback to the nervous system regarding joint position and speed of movement.

Research using magnetic resonance imaging of athletes with hip pain has revealed wasting or decreased muscle mass in some of the deep rotators of the hip. These deep hip muscles attach very close to the joint axis, which are predominately slow-twitch, endurance muscles, namely:

- quadratus femoris
- gluteus minimus
- obturator internus and externus
- the gemelli.

Researchers have referred to these muscles as the 'rotator cuff' of the hip joint. Emphasising the importance of iliopsoas in controlling the anterior part of the joint.

The following two exercises are early stage rehab work to help to recruit the deep stability muscles of the hip.

1. Hip suck (tonic psoas recruitment)
Start in a sitting position or lying on your back. Feel the front of the hip over the psoas insertion (which is on a bony prominence just below the hip joint) and try to draw the hip into the socket of the hip joint. You should feel this deep in the groin. You should not feel rectus femoris (the middle quadracep muscle) or tensor fascia lata (located on the lateral side of the leg) tighten or contract. Hold the position for 10 secs. Repeat for 10 contractions.

2. Heel squeeze (deep hip rotator activation)

Lie on your front with knees bent and hips slightly spread apart. Then gently push the heels together with minimal effort and no gluteal contraction. You can check that your gluteal muscles have not contracted by feeling this muscle while conducting the exercise to confirm that it does not feel tight.

The key to progression is being able to incorporate these deep muscular contractions into higher-level exercises. For example, try and activate the psoas muscles (as explained in 'hip suck' exercise) when performing a squat. Performing the psoas hip suck before going down into the squat. This will help to achieve good hip flexion without a great deal of lumbar spine flexion. You should also learn to incorporate these deep muscular feelings into everyday activities such as walking or sitting.

These two exercises and ethos should be incorporated at the earliest stage of rehab to bring about local joint control. Then work on good postural alignment and muscle length can be carried out.

So, for instance, there is little point undertaking a lot of stretching of the groin muscles in circumstances where the underlying problem is one of instability of the pelvic joints. But on the other hand, it would be wasted work to improve deep muscle control without strengthening the larger hip muscles that promote improved postural control and resistance to large external forces in everyday sports.

The idea of the hip rotator cuff can be viewed as part of the deep muscle fibre systems that are aligned horizontally – namely pelvic floor, piriformis, internal oblique and transversus abdominis – thereby extending and complementing the concept of core stability.

Reference

1. Boden B, Speer K, 'Femoral stress fractures' Clinical Sports Medicine 1997:16(2):307-317

Beyond rehab: pelvic assessment

Chris Mallac ***discusses post-injury rehabilitation for athletes; taking a closer look at the pelvis***

I believe it is important for therapists who are involved with elite squads to adopt a proactive and thorough approach to the routine monitoring of previously injured athletes upon their return to play. One aspect of that monitoring is the daily screening of pelvic biomechanics.

The athlete returning from a recent soft tissue strain belongs to the 'at risk' group of clients who need daily ongoing assessment and maintenance. They represent possibly the most challenging and time-consuming category of clients that a therapist dealing with a large squad will encounter.

The purpose of this article, therefore, is to briefly explain the rationale and basis of pelvic assessment in the ongoing management of the previously injured athlete. This is by no means a comprehensive explanation of pelvic function/dysfunction or the assessment and treatment of pelvic mechanics.

Why should there be a need to focus on pelvic monitoring? For two important reasons:

Generally speaking, the pelvis will have contributed significantly to the athlete having suffered the muscle strain injury in the first place. This may have been cause or effect – either way, dysfunctions need to be addressed if the athlete is to progress and avoid suffering re-injury.

Athletes returning from a recent muscle strain are more susceptible to changes in muscle tone around the pelvis and thus in pelvic position and joint play. This is because of the

complex neurological arrangement between the nervous system and the muscles that attach to and control pelvic movement.

Not all readers are going to be equipped to carry out the following tests. But while it takes considerable skill to become adept at using the kinds of tests described here, it is nevertheless useful for a range of sports support professionals to be aware of the value of this kind of monitoring, not least to be able to reflect on whether and how you might complement the work described here to help maintain the player's fitness and good health.

Setting the scene

If a therapist is in charge of the ongoing musculoskeletal management of a squad of athletes (let's say 45 rugby players in an elite squad), they are likely to be fielding multiple athlete complaints of aches/pains and issues that develop from one day to the next.

It is common for a physiotherapist to be confronted with an athlete seeking attention after an 8am team meeting soon to be followed by a 90-minute on-field training session, who is complaining of a tight lower back and tight hamstring that he only noticed upon waking that morning. This particular athlete has also recently returned from a Grade I hamstring strain. The physios may for example, also have a squad of 45 players all needing attention to strap a thumb, quickly loosen a stiff ankle or help with a routine hip-flexor stretch prior to hitting the training field, and three on-field coaches who need this player out on the field in 10 minutes, as he is a vital part of the upcoming weekend's game. So what does the physio do and what can you do as an athlete or sports coach?

Quick screens

The first thing you need to do is form a mental picture of what is 'normal' for this athlete in terms of hamstring range of motion and pelvic mechanics. For a physio this is easy to compare, as you will have assessed these aspects multiple times before. But as the athlete or coach it will be primarily about

setting bench marks about what you are likely to feel and consistently testing in similar conditions.

Ask the athlete to lie supine (on back) and run through a checklist of screening tests for the pelvis. The screening tests you need to run through are:
i. pelvic innominate position
ii. pelvic arthrokinematics
iii. muscle tone.

These are quick to perform (less than three minutes in total) and will immediately lead you to a choice of three possible outcomes so you can make a prompt decision about the athletes' performance potential. The possibilities are:
- everything has gone haywire and this athlete will not be training today as the injury risk is too great
- things have changed a bit and you need some time to attempt to restore the balance
- things are not too bad, the athlete can warm up and you will monitor how they travel through training.

Screen 1: position of pelvic innominates

Lie the athlete supine.

Anterior/posterior rotation

Feel for the anterior superior iliac spines (ASIS); compare their relative anterior (forward) and posterior (backward) positions and their cephalad/superior (towards the head) and caudad/inferior (towards the feet) positions. If one ASIS is forwards and down (anterior and inferior) compared with the other side, then the ilium on that side is anteriorly rotated (but note, it may in fact be that the other side is posteriorly rotated – you will need to defer your conclusion on which side is dysfunctional until you do the arthrokinematic tests). If the ASIS sits upwards and backwards (posterior and superior), then it is posteriorly rotated. This needs to be confirmed with the position of the posterior superior iliac spines (PSIS) in prone, as only then will you be able to determine if you are looking at a true rotation or an upslip or downslip (see below).

Inflare/outflare
At the same time, compare whether the ASIS is farther from the midline (outflared), or closer to the midline (inflared). It is common to compare the ASIS to the umbilicus for this purpose, but beware: the umbilicus is often 'off centre' because of the pull of the lower transverses abdominis towards the side of any outflare. It is better to confirm ASIS position with a more fixed anatomical structure such as the sternum, which should pretty much be right in the centre line of the body. If you find an anterior/inferior rotation of the ilium, there will often also be an outflare on the same side.

Lie the athlete prone.
Confirm rotation and flare or upslip/downslip
Feel for the PSIS and compare with what you saw anteriorly. If you saw the right ASIS was down and forward (anterior rotation) then you should see the right PSIS is up and forwards (also anterior rotation of that ilium). This confirms a rotation. If the PSIS also happens to be down (inferior) then both the ASIS and PSIS have moved towards the feet and this represents a downslip of the ilium.

It is much more common in an athlete with a dysfunction to see an innominate rotation of the ilium than a slip. Upslips and downslips are more usually associated with trauma such as a heavy fall on to the ischial tuberosity (causing an upslip), or having the foot yanked heavily away from the body (causing a downslip).

It would be very unusual for an athlete who has never demonstrated a down- or upslip suddenly to develop one without a history of recent trauma. Sudden changes are more likely to be rotations and flares.

Screen 2: arthrokinematic tests

In supine (lying on back), it is quick and simple to perform a basic joint-play test such as a 'squish test'. This is done by cupping the hand and placing the base of the thumb over the superior part of the ASIS. The therapist uses gentle pressure through

extended arms to attempt to move the ilium posteriorly (from behind). If one of the innominates moves more freely than the other, then one of the SIJ joints may be hypomobile or blocked.

Other texts describe these tests in much more detail with lots of photographs that illustrate these joint play tests. However, irrespective of the quality of the description and diagrams, mastering these tests comes down to years of feeling countless athletes and their innominate movement. The execution and interpretation of these quick tests has a level of complexity that words and pictures cannot adequately convey.

In athletes, increases in myogenic (muscle) tone in and around the pelvis is generally responsible for sudden changes in pelvic innominate positions and 'squish' tests.

Screen 3: muscle tone

If you feel that your athlete's innominate position is suddenly different from normal, and their 'squish' tests feel a little more blocked than usual, you know the athlete may be in a bit of a risky situation, suggesting that further assessment and treatment

Table 1: Pelvic asymmetry and related muscle tightnesses

	Anterior rotation	Posterior rotation	Inflare	Outflare	Upslip	Downslip (rare)
Tensor fascia lata (TFL)	✔			✔		
Psoas	✔				✔ (usually with QL)	
Iliacus	✔			✔	✔ (usually with QL)	
Quadratus lumborum (QL)	✔			✔	✔	
Gluteus medius (posterior fibres)		✔	✔			
Adductor magnus		✔	✔			✔
Iliolumbar ligaments	✔			✔	✔	
External oblique		✔			✔	
Rectus abdominis		✔				

may be necessary to try and shift pelvic position and extent of joint play before you give them the go-ahead to train.

Usually, it is a sudden increase in muscle tone somewhere in the pelvic system that will have led to the change in innominate position and blocked pelvic joint play. The cause may have been heavy training the previous day, a sudden increase in leg loading in the gym or an abnormal prolonged resting position, such as a long drive. The therapist can use trigger-point therapy (preferred), muscle energy techniques (least preferred) or aggressive stretching to normalise muscle tone can also be carried out by the athlete or coach.

There is a whole collection of pelvic muscles that contribute to altered pelvic positions and joint play, and to work out the offending muscle/s can sometimes be a minefield. The best way is gently to feel the resting muscle tone, and if a particular muscle feels high-tone, treat this one and then reassess position and joint play.

As a rule of thumb, feel for the most superficial muscles first, as tissues such as the TFL (tensor fascia latae), posterior fibres of gluteus medius, and quadratus lumborum have the greatest leverage to cause rotations and flares. Table 1 presents some of the more common offending muscles and associated pelvic asymmetry. Be warned, this is a guide only, not an exact description of which muscles cause which asymmetry. The chart is my own interpretation, based on years of experience and the guidance of other therapists with even more years of experience.

To make the all-important judgement call about when you or your athlete is susceptible to further re-injury after a muscle strain injury, you need a bit more to go on than guesswork and intuition. If you have experienced the injury yourself or as a coach been there through the entire injury and rehabilitation process, then you will have formulated a 'window' of normality in terms of pelvic position, joint play tests and the feel of muscle tone.

If you believe you or your athlete has fallen out of the specific window of normality in these areas, then training must stop and a form of management must follow until acceptable ranges are

reached. This could take anything from a few minutes to a few days to correct, but to attempt to train through such a significant change may result in re-injury, more time away from sport and the usual disruptive and stressful consequences for team mates, coaches, athletes and medical staff.

Hip-muscle imbalances can cause back and hamstring troubles. Here are two case studies

Muscle imbalance is related to two changes in muscle function: (1) a tightening of a "mobiliser" muscle and (2) weakening of a "stabiliser" muscle. Mobiliser muscles are those that produce movement; they are often big muscle groups with more fast-twitch fibres. Although they produce high power, these muscles have a tendency to shorten. The hamstrings and rectus femoris (one of the quadracep muscles) are the two main mobiliser muscles around the hip joint. In contrast, stabiliser muscles control movement or joint position, often working against gravity. They are smaller, deeper muscles which often have more slow-twitch fibres. They should be well coordinated and have good endurance capacity, though they have a tendency to be under-active and weak. The gluteals are the key stabiliser muscles around the hip joint.

What happens if a mobiliser muscle tightens? There are two main problems associated with tight mobiliser muscles. (i) The limited range of motion can affect movement and place greater stress on the joints and (ii) the tightness in the muscle may inhibit the opposing muscle group through a process called reciprocal innervation. For example, a tight rectus femoris can inhibit gluteus maximus activity.

What happens if a stabiliser muscle weakens? The main problem with weak stabiliser muscles is that they do not have sufficient endurance to hold a position – usually against gravity – for long enough. Sometimes this can be related to a chronic lengthening of the muscle. If this occurs, the force-length

relationship within the muscle changes, resulting in an inability of the muscle to hold an "inner range" position.

The muscle may appear strong on a dynamic test, but is unable to stabilise a joint for a long time holding a static contraction, this being the usual role of a stabiliser muscle. When this chronic lengthening occurs, the stabiliser muscle becomes inactive and joint stability is compromised. Sometimes the adjacent mobiliser muscle becomes overloaded as it tries to compensate for the lack of stability function. For example, lengthened gluteus medius reduces pelvic stability during one-leg support and may overload the tensor fascia lata muscle which can lead to a tightening of the iliotibial band.

How to check

To assess for muscle imbalance one needs to combine flexibility tests for the mobiliser muscles with inner range holding tests of the stabiliser muscles. An example of a flexibility test is the SLR (straight leg raise) test for the hamstrings. You will need to carry this test out on a partner. Your partner lies on his/her back with the knees bent. Take your partners leg and straighten it at the knee. Place your hand under your partners lumbar spine (lower back) and slowly raise the straightened leg. If the hamstrings are flexible enough the leg will raise to about 90 degrees until the hamstrings pull on the lumbar spine. A short hamstring will start to pull the lumbar spine much earlier.

An example of an inner range holding test is the prone leg lift for the gluteus maximus. Your partner lies on his/her front and bending one knee to 90 degrees, lifts the thigh a little off the floor. Your partner should be able to get a strong contraction of gluteal muscle to do this and be able to hold the static contraction for 60 seconds. If this position places too much strain on the hamstring or lower back, or the leg starts shaking, then your partner is unable to recruit the gluteal muscles sufficiently to hold this position.

(The reference for the above description is Christopher Norris 2000, *Back Stability*, *Human Kinetics*)

Take these two examples

The following two case studies are excellent examples of how performing muscle imbalance tests can help you to devise an appropriate rehabilitation programme for athletes with back and hamstring trouble.

The main advantage of this approach is that the rehab muscle training is specific to the function required of that muscle, eg, a stabilising muscle is trained with static and slow controlled exercises emphasising endurance, which is exactly how this muscle would work in daily life and exercise.

Case Study 1: Niggling back pains

Profile: This client suffered from niggling back pains that became very bad if she played any kind of sport. When she came to me her training goals were to improve her back problems as well as to get fitter.

Assessment: We tested her flexibility in most major muscle groups and discovered she was tight in the rectus femoris and adductors. The stability tests showed that she was completely unable to hold the inner range of the gluteus medius and the inner range of the illiopsoas and gluteus maximus both fatigued before 60 seconds. Her posture was also slightly lordotic, which means her pelvis is tilted upwards, extending the lumbar spine.

Analysis: The tight adductors could inhibit the gluteus medius and the tight rectus femoris could inhibit gluteus maximus as well as contribute to her poor posture. In general, the poor endurance of her hip stabiliser muscles meant that any athletic movements were putting too much stress on her back.

Exercise programme: The following exercises were chosen to address the above imbalances and problems. These were completed two-to-three times each week.

'To assess for muscle imbalance one needs to combine flexibility tests for the mobiliser muscles with inner range holding tests of the stabiliser muscles'

Prone leg lifts (Gluteus maximus exercise)

As the athlete lies on her front, with one leg bent at the knee, lift the knee off the floor, focusing on activating the gluteal muscles. Hold the position, squeezing in the buttocks, for 10 secs. Repeat 10 times.

Ball sitting one-leg lifts

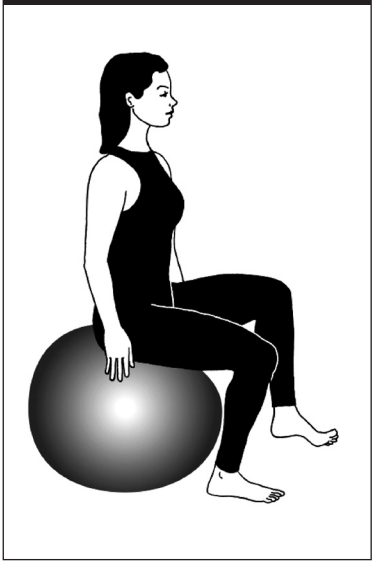


Table top (Gluteal and lumbar stability exercise)

Kneel on all fours with hands under shoulders and knees under hips. Ensure the spine is in "neutral" and then contract the deep abdominal and pelvic floor muscles to secure this position. Slowly take one leg away behind you keeping the back and pelvis stable. Perform 10 each side slowly, focusing on pelvic stability. If you do this correctly, your back is flat and stable like a table top.

Abductor machine (Gluteus medius exercise)

Using the abductor machine with a light weight you can perform inner range movements. Take the legs out to the widest position and then very slowly pulse the legs in and out 20 times. The movement should be no greater than 4 in. each leg and should be always controlled by the hip muscles, especially on the in phase. Do three sets to build up endurance.

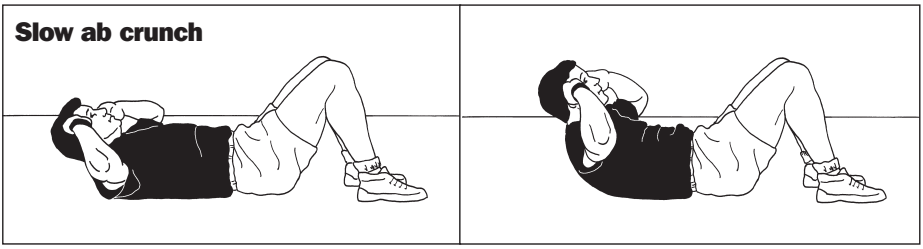
Ball sitting one-leg lifts (Illiopsoas exercise and lumbar stability)

Sit with perfect posture on a gym ball. Contract your deep abdominal muscles to support your lumbar spine and lift one leg off the floor slightly. Hold the leg up, but ensure that you do not lean back or allow the lumbar spine to flex. Hold for 10 seconds and repeat 10 times each side.

Slow ab crunch (Abdominals exercise)

Lying on your back with knees bent. Lift up head so chin is near chest. Contract the pelvic floor to support lower back. Very slowly curl up the shoulders, using only the abdominal muscles. Your pelvis should not tilt, nor should your legs move. Hold the top position for two counts and slowly curl back down. Do not allow your head to go back. Three sets of 20 repetitions.

Slow ab crunch



Hip flexor stretch

Go down to a lunge kneeling position and tilt the pelvis forwards by squeezing the buttocks. Then move your hips forward, stretching the rear hip flexor. Hold for 30 seconds each side.

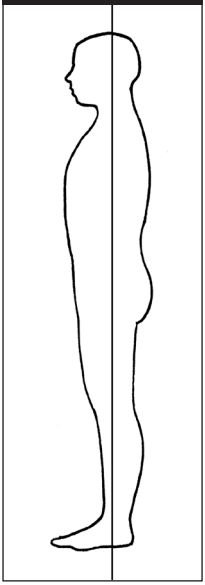
Adductor stretch

Sit upright and place the soles of your feet together. Open your knees as wide as possible and hold for 30 seconds.

Posture education

Some time was spent each session on posture education, in particular learning the correct lumbar spine position while standing, ie, "neutral", and what this position feels like.

Optimal posture



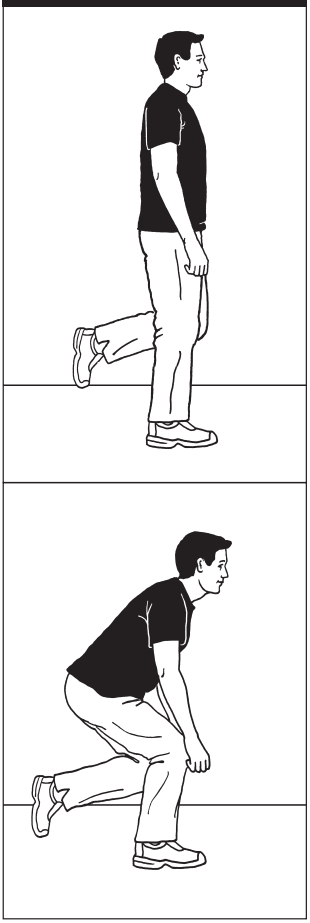
And the results?

After a few weeks this exercise routine produced big improvements. The nagging back pain vanished from daily life and the athlete's muscle function of the hip stabilisers was much improved. In general, her posture and self awareness during movements were also much better. The next stage is to build on this basic stability improvement and work on more complex exercises to ensure the back is always supported during sports.

Case Study: 2 A dodgy hamstring

Profile: This athlete was suffering from a recurring hamstring strain, which usually flared up as the volume or intensity of training was increased. The goal was to be able to run regularly pain-free.

One-leg squat



Assessment: We completed all the flexibility and inner range tests as in Case Study 1. In this case, the athlete only failed two tests: (a) he had tight rectus femoris and (b) his inner range endurance in the gluteus maximus muscle was poor. In addition, his posture was slightly lordotic.

Analysis: The tight hip flexor could be inhibiting the gluteus maximus. Poor stability function of the gluteus maximus could place greater strain on the hamstring during running since the hamstring has to perform both stabilising of the trunk and extending the hip. This is a common cause of hamstring strain.

Exercise programme: The following simple exercise routine was followed five times a week.

Prone leg lifts (Gluteus maximus exercise) As described.

One-leg squats. (Gluteal and quadriceps functional exercise.) Stand on one leg and keeping the knee in line with the toes squat down, lowering your bum back as though you were sitting on a chair. Go down in control as far as you can and then stand back up. Ensure you stand up fully in between each repetition and achieve good posture. Perform two sets of 10 each leg.

Slow ab crunch. As described.

Hip flexor stretch. As described.

Results?

Within two weeks of carrying out this routine, this athlete was suffering no symptoms, his posture and running style had improved due to greater hip flexibility and gluteal support (he was able to maintain a more upright posture) and he was running faster with no pain.

Raphael Brandon

The Buzzy broomstick

Chris Mallac *has some unusual advice on how athletes can self-manage tricky psoas muscle problems*

Sports and musculoskeletal therapists are well versed in educating athletes on self-management of muscle tone/tightness problems and self-release techniques for trigger points. Indeed, 'trigger balls', muscle mates and tennis/golf balls are common contents in the kit bags of athletes, for self-treatment in hotels while on tour, or after training sessions. However, certain muscles in the body, such as the psoas, are particularly tricky when it comes to self-management techniques.

The psoas is a deep hip muscle that has often been clinically implicated in low back pain syndromes and problems of the groin and pelvis. Here, we look at a novel way to self-manage psoas trigger points using a broomstick. I have called this the 'Buzzy broomstick' out of respect for the former international rugby player Mark 'Buzzy' Connors, who first showed me this innovative technique.

Psoas muscle anatomy and function

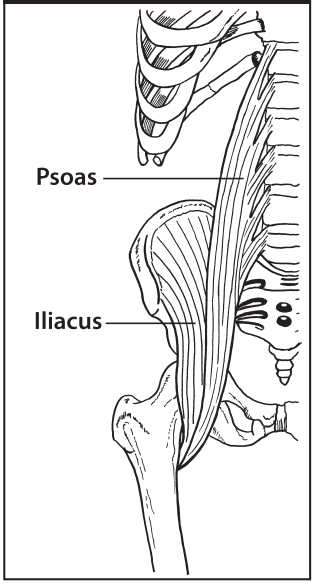
The psoas is a deep hip muscle that originates on the vertebral bodies and transverse processes of the lumbar vertebrae (L1-5) and discs of T12/L1 to L4/5 (*see Figure 1 overleaf*). It is functionally divided into psoas major and minor, although it will be considered as a single muscle here. It courses vertically downwards to cross the front of the pelvis and insert on to the lesser trochanter (inside edge) of the femur. It is innervated by branches of the L1-3 lumbar spinal nerve roots.

The main functions of this muscle are:

i. to flex the hip

ii. to compress the spine (in the vertical direction)

Figure 1: the psoas muscle



iii. to flex the trunk with bilateral contraction (with the thigh fixed)
iv. to flex one side of the trunk with unilateral contraction (with the thigh fixed).

Of particular anatomical interest is the close relationship the psoas has with the ilioinguinal nerve and the iliopectineal bursa.

Ilioinguinal nerve: The ilioinguinal nerve arises from the L1 lumbar nerve. It emerges laterally at the psoas muscle and then passes in front of the posterior abdominal wall, running around the trunk and down through the inguinal canal. It terminates on the inner front of the groin. The nerve innervates the lower transversus abdominis muscle and supplies sensation to the inner groin area.

This relationship between psoas dysfunction and groin problems has always been of interest to sports medicine practitioners. It has often been argued that psoas tightness will lead to movement dysfunction around the hip and pelvis, and this can lead to breakdown of the myofascial elements around the lower abdomen and groin region.

However, the ilioinguinal nerve may also cause problems as a result of its close anatomical relationship to the psoas muscle. It is hypothetical that the muscle-nerve relationship might be a precursor to groin syndromes.

An additional muscle-nerve relationship is, the transversus abdominis and the ilioinguinal nerve. Inhibition and dysfunction in the firing in this muscle may then lead to delayed and ineffective stability at the lumbar spine and the symphysis pubis. This in turn may produce excessive force around the symphysis during movement, resulting in breakdown of the joint.

Iliopectineal bursa This bursa (sac of fluid) lies between the lower psoas muscle and the iliopectineal eminence of the pelvis. It acts as a cushion to reduce friction between muscle and bone

during muscle contraction. It has been suggested that an excessively tight psoas muscle and repeated hyperextension of the hip (as with kicking) may predispose this bursa to excessive friction and compression, causing an acutely painful bursitis.

Pathology and dysfunction in the psoas

There is not much published literature examining the contribution of psoas/iliopsoas to musculoskeletal problems around the lumbar spine and groin. A few studies have demonstrated a reduction in the cross- sectional area of the muscle at the level of spinal dysfunction. Cooper (1992)[1] found atrophy (wasting) in the psoas in patients with recent and chronic low back pain, with more pronounced wasting in the chronic back pain sufferers. Dangaria and Naesh (1998)[2] looked at psoas major in the context of unilateral sciatica associated with disc problems, and found a reduction in the cross-sectional area of the muscle at the level and the site of disc injury.

The presence and management of trigger points has received a great deal of interest in the sports medicine literature over the years. Citing six case studies, Ingber (1989)[3] demonstrated that he was able to improve hip and spinal extension and reduce low back pain in patients after iliopsoas trigger point injections (dry needling).

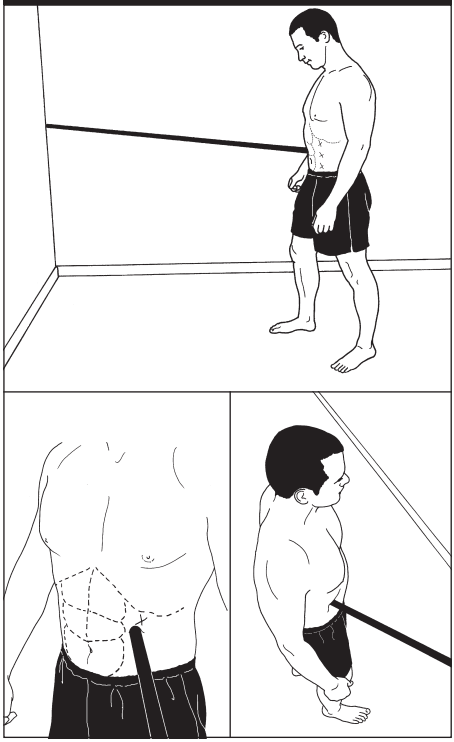
According to Travell and Simons[4], iliopsoas trigger points may refer pain laterally to the lumbar spine and into the sacroiliac joint. This may occur with sitting, standing, lifting and getting out of a sitting position. This commonly imitates discogenic back pain. The therapist may assess that hip extension is restricted, the client stands with extreme lumbar lordosis and/or may be unable to stand upright. At www.tandempoint.com/p20.htm you can refer to the classic Travell and Simons diagram that highlights psoas trigger points and their referral pattern.

Self-management with the Buzzy broomstick

Assessment

Prior to any athlete impaling themselves on a broomstick, it is

Figure 2: using the broomstick



best that they consult a sports physiotherapist to assess the psoas muscle and its involvement in any lower back problems or pelvic/groin problems they may be suffering. Accurate location of the psoas for trigger points is necessary so that the athlete has an appreciation and 'feel' for depth of penetration through the abdominal wall to access this deeply situated muscle.

The stick

If it's not possible to raid the nearest quidditch match, the athlete will need to pick up a 6ft broomstick from a local hardware store. One end of the stick should be rounded to avoid causing a great deal of pain and discomfort.

The position *(Figure 2)*

Place one end of the broomstick into a corner at approx hip height. Standing in front of the broomstick but slightly off centre, place the rounded end of the stick 1in to 2in (2.5cm to 5cm) lateral to the rectus abdominis (six-pack) muscle. This is the best position to find the psoas muscle. The exact height of penetration will depend on where the trigger points are located in the muscle. As a guide, starting at umbilical height and working up and down from there, you should find some nice and nasty trigger points. The key to this self-management technique is to keep the abdominals completely relaxed to allow easy and pain-free penetration into the deeply situated psoas muscle.

A variation on the standing position shown in figure 2 is to perform the same procedure in sitting. The benefit of sitting is that the abdominal muscles are completely relaxed and off-stretch, making it easier to penetrate the abdominal wall. The

downside is that the psoas is also off-stretch, and often the best trigger points are found with the hip in neutral or slight extension (as it would be in standing).

The length of hold on the trigger point and frequency of treatment will very much depend on the individual. A psoas subjected to repeated stress in the form of hip flexion movements (eg cycling) may require prolonged and deep treatment to relieve any longstanding muscle tone issues.

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Acetabular labrum tears

An injury that plagues one in five athletes with groin problems
Elizabeth Ashby *and* **Fares Haddad** *explain*

Acetabular labrum tears are a common cause of time away from sport in athletes. First described in 1957, it is only in the last 15 years, with advances in imaging and hip arthroscopy, that such lesions have been recognised as a common cause of groin pain in athletes. Other causes of groin pain include adductor strains, inguinal and femoral hernias, nerve entrapment, stress fractures of the femoral neck, avulsion fractures of the pelvis, osteitis pubis, intra-abdominal disorders and referred back pain.

Acetabular labrum lesions that may have gone unrecognised in the past can now be seen using magnetic resonance arthrography and inspected directly using hip arthroscopy, followed by either arthroscopic resection (cutting back) or repair.

Function of the acetabular labrum

The acetabular labrum is a ring of fibrocartilage that attaches to the circular outer edge of the acetabulum (hip socket). The labrum has a highly variable shape and three surfaces:

- a basal surface which connects the labrum to the acetabular bony rim
- an internal articular surface which is in continuation with the articular surface of the acetabulum
- an external surface where the hip joint capsule attaches.

The main function of the acetabular labrum is to improve hip joint stability in two ways. Firstly it deepens the hip socket, providing it with extra structural support. Secondly it partially seals the joint which counteracts any distractive (pulling-apart) forces.

How injuries occur

The five most common causes of acetabular labrum tears are:

- trauma
- hip dysplasia (congenital abnormality)
- degeneration
- capsular laxity
- femoro-acetabular impingement.

In athletes, the main cause of tears is trauma, usually from a twisting or pivoting motion whilst weight-bearing. Such movements are common in football and hence the acetabular labral tear is often referred to as 'footballer's hip'. Athletes with hip dysplasia (a congenital or acquired deformation or misalignment of the hip joint) are at greater risk of developing a labral tear compared with those with a normal hip joint. Dysplastic hips are more common in hyper-mobile individuals such as dancers and track and field athletes.

Symptoms and diagnosis

The presentation of acetabular labral tears is very inconsistent but the most common complaint is a sharp groin pain after trauma. Other possible sites of pain are the front of thigh, hip and buttock region. Other symptoms include clicking, locking and 'giving way' of the hip. The pain may be reproduced in sport by weight-bearing activities that require twisting, such as kicking a football.

Examination of the hip is often entirely normal with a full range of movement. There are specific tests for a labral tear. The impingement test (flexion, adduction and internal rotation of the hip joint) commonly produces pain or a clicking sensation when an antero-superior (situated in front and above) tear is present. The McCarthy test involves flexing both hips and then extending the affected hip – athletes with a labral tear will feel a catch.

Plain radiographs, computed tomography (CT), magnetic resonance imaging (MRI) and arthrograms are all poor at identifying intra-articular disease. However, magnetic resonance arthrography (MRa) is proving to be more

promising. MRa involves the injection of dye into the hip capsule followed by MR imaging in several planes.

Since a single radiological technique does not exist at present that can accurately diagnose labrum tears, diagnosis is usually based on a combination of clinical judgement, MRa and hip arthroscopy.

Hip arthroscopy has become increasingly popular over the last 15 years with the development of minimally invasive instruments and techniques. It is usually performed as a day-case procedure under general anaesthetic and takes approximately 30 to 40 minutes.

Arthroscopy can be used both to diagnose and to treat acetabular labrum tears. Diagnostic arthroscopic evaluation is considered when joint symptoms, examination and radiographic studies have failed to provide a diagnosis. Arthroscopy is reported to facilitate a diagnosis in 40% of these cases.

Treatment

Treatment can be conservative or surgical. Conservative management involves rest followed by a graded increase in weight-bearing. Traction can also be used. But as yet there is no evidence as to whether the inner two-thirds of the labrum, which lack any blood supply, are able to heal with rest alone.

Surgical treatment is either arthroscopic debridement (tidying up) or repair. Debridement involves removal of damaged tissue back to a stable base while preserving as much of the labrum as possible. Techniques are evolving for repair such as suture anchor. The aim of arthroscopic treatment is to eliminate any unstable flap of labral cartilage, which is thought to relieve groin pain. This in turn should maintain normal function of the hip joint.

Post-operatively there is usually four to five days of relative rest prior to starting a rehabilitation programme with gentle mobilisation of the hip joint. Exercises in a hydrotherapy pool are particularly effective, as they allow gentle movement without compression through the joint. Progressive muscle strengthening is undertaken and once the hip has a normal

range of motion and strength, functional exercises can be started. A return to sport is usually possible two to three months after the operation.

Arthroscopic debridement is reported to improve symptoms in 67% to 90% of patients. Overall, younger patients and those with no arthritis have a better outcome.

Conclusion

Up to 20% of groin pain in athletes is now thought to be the result of acetabular labrum tears. All health care professionals who work with athletes should have a high index of suspicion for such lesions. Diagnostic tools include MRa and arthroscopy. Treatment is hip arthroscopy with debridement (tidying up) or repair and preliminary studies suggest a positive outcome.

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A further case study: a rugby union player with groin pain

This 18-year-old young man is a Rugby-Union player in his final year at school, having been chosen to play for a national junior squad and poached by a prestigious premier club as a fly half or winger. All was going well until October the year before last when he started developing left-sided groin pain, although the right was occasionally achey as well.

Initially the pain was present early on in a match or training session, but gradually the ache developed into a sharper pain, especially before being fully warmed up, for two to three days before a match. After three or four weeks, he decided to rest for one week, but found the pain was worse when he resumed training, or even when running. He persisted until one particular day in mid-December when the pain became so sharp he had to stop playing. Finally, he sought help at our injury clinic.

He had constant pain on any movement of his hip; walking was difficult. His pain seemed centred at a point halfway between the pubic symphysis and the front of hip bone and deep inside. Almost every hip movement caused pain, whether active (he moved leg using hip joint) or passive (I moved the leg using the hip joint); internal rotation and adduction were the most painful and restricted, with resisted tests for the adductors also being very weak and painful. I was able to feel a small mal-alignment of the pubic symphysis and general muscle tenderness in the area, but no evidence of aductor tendon disturbance or of a hernia. Negative X-rays and bone scan ruled out stress fractures or early degenerative or rheumatic changes. As ice, rest and NSAIDs (nonsteroidal anti-

'Though very fit and muscular, it was found that he had very poor muscle control around his pelvis and trunk, especially of gluteus maximus. He had compensated for this by gaining his sprint propulsion from very large calves'

inflammatory drug, such as aspirin or ibuprofen) quickly reduced the pain and inflammation, it became clear that the primary restrictions were in the hip joint capsule. The diagnosis was made: an anteromedial (located to the front and inside) hip joint impingement (mechanical disorder) and capsulitis (inflammation of the tissues enclosing the joint), with major muscle imbalance factors directly relating to the hip dysfunction.

'Though very fit and muscular, it was found that he had very poor muscle control around his pelvis and trunk, especially of gluteus maximus. He had compensated for this by gaining his sprint propulsion from very large calves'

Biomechanical assessment of his trunk/pelvis/hips and lower limbs revealed an interesting pattern of dysfunction that had to be addressed early on in order to maximise the speed of his recovery and his return to competitive sport.

Though very fit and muscular, it was found that he had very poor muscle control around his pelvis and trunk, especially of gluteus maximus. He had compensated for this by gaining his sprint propulsion from very large calves, and the piriformis and gluteus medius muscles had become very tight and weak, causing dysfunction around the hip joint and severely limiting his straight-leg raise/hamstring flexibility on that side. There was also an inability to recruit/use transverse and oblique abdominal muscles to control the movement of his pelvis in running, although his rectus abdominis ('six-pack') muscles were great!

Treatment progressed on three levels:

1. Anti-inflammatory agents, particularly NSAIDs, were used right up until he began training again, with gradual reduction, and then he was carefully weaned off.
2. Hip mobilisation was achieved by using seat belts to gain a gradually firmer distraction element, and then progressing hip range of movement to finally gaining full internal rotation, flexion and ad/abduction. The success of the treatment hinged on gaining and maintaining full hip range of movement,

especially when he began running, and then full training. He would only be progressed to the next level of activity if it was pain-free during and after, and if his muscle control and endurance were improving to match the level of activity.
3. The principles of muscle and movement rehabilitation initially were to use static holds and then add in movement – first with concentric, then eccentric loading, without losing the neutral pelvic positions. A flexibility routine was established early on, which he always carries out before any activity. However, strength and re-education exercises were only to be done AFTER a run in order not to fatigue the postural muscles and thereby sabotage his running technique. However, the bottom line, literally, was that 'that little butt' had to grow or he'd never be the union player he wanted to be!

He is back in full training now and aiming to play at the earliest opportunity. The lesson to be learnt from a situation such as this is that you must never lose your focus on what you are aiming to achieve with treatment, be it any one or more of the three above problems that need to be addressed. If the results are not forthcoming, particularly with groin injuries, you have to ask which of the problems has not been sufficiently dealt with.

Ulrik Larsen

Rehabilitating Groin Injuries

Chris Mallac *discusses effective rehabilitation for the debilitating groin injury*

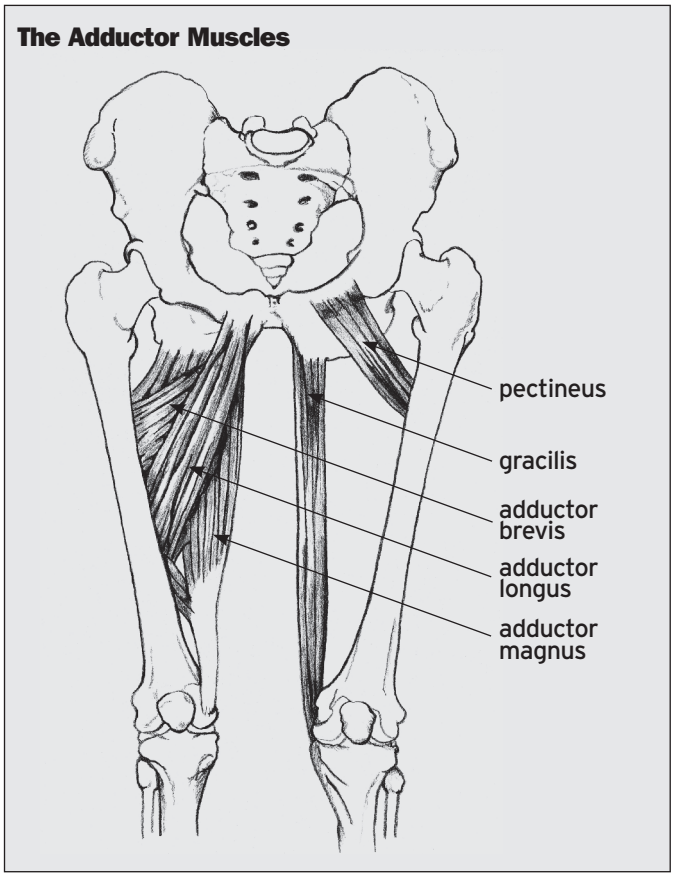
Of all the soft-tissue injuries the athlete can suffer, groin injuries are potentially the most debilitating and frustrating of all, especially in terms of time lost from competition and return to full competitive fitness. The co-existence of multiple issues is the most plausible explanation for this observed difficulty in management. It is common for athletes to shop around seeking different medical opinions for their ongoing groin pain, and to receive varying medical suggestions as to where the problem originates.

Type of injury

It is important to remember that groin problems often have more than one possible cause existing. Groin injuries are notorious for 'co-existing pathologies'.

The 'big three' when considering ongoing chronic groin pain are adductor tendinopathy (disease of the tendon, either inflammation or damage to a tendon), osteitis pubis (injury to the cartilaginous joint of the pubic symphysis) and inguinal (sportsman's) hernia. It is not uncommon to see two or even all three of these conditions co-existing at the same time. However, there still exists a myriad of other conditions that may be affecting the groin area.

It is beyond the scope of this article to discuss all the presenting signs and symptoms of all these differentials. That in itself takes up entire chapters in sports medicine textbooks, and if done well should take up whole textbooks. For those



interested, review Peter Brukner and Karim Khan's text Clinical Sports Medicine (McGraw-Hill Book Company).

Relevant anatomy

The adductor muscle group consists of the adductor longus/brevis/magnus, pectineus and gracilis. Of these, the adductor longus is the most superficial (close to the surface) and easiest to find or feel. Along with the gracilis, it is also the most easily injured.

In relation to the groin area, one must appreciate that within a hand's breadth space, there exist a number of important

anatomical structures that may present as a pathological entity. Above the pubic ramus (suprapubic groin pain) we have the conjoined tendon and its close cousin the inguinal canal. It is in and around the inguinal canal where inguinal (sportsman's) hernias develop. Other rarer forms of hernias are umbilical hernias and Sprengel's hernias. Around this area we also have the abdominal insertions (rectus is of prime importance) and more intimately associated with the pubic ramus is the pubic symphysis. Deep in the suprapubic area we also have the psoas muscle and high lumbar segmental nerves such as the ilioinguinal nerve and iliohypogastric nerve.

Below the pubic ramus (infrapubic groin pain) we have all the adductors and their respective tendons. The other dominant structure is the obturator nerve which has received a degree of recent interest, especially from the medical people at the Olympic Park Sports Medicine Centre in Melbourne, Australia

'Adductor muscles are more commonly strained in sports involving twisting, turning, stepping and kicking, such as all codes of football'

Injury mechanisms

Adductor muscles are more commonly strained in sports involving twisting, turning, stepping and kicking, such as all codes of football. They are less commonly injured in straight-line sprinting, with acceleration being the dominant mechanism of injury with this sort of running. Similarly with hamstring injuries, adductor muscle injuries come about because of excessively strong contraction or excessive stretch.

One school of thought, and this would include hamstring injuries and groin injuries, suggests that a muscle must have pre-existing increased tone in order to tear/strain. This rationale maintains that an increase in tone due to some sort of altered afferent input brings a normally healthy muscle closer to its tensile breaking point. Any excessive stretch or contraction may possibly cause the muscle to tear. This reasoning gains some weight in support when one considers how often a pre-existing pathology such as osteitis pubis or an inguinal hernia is soon followed by an adductor muscle tear or vice versa.

It is important to note that, repetitive sprinting, turning and

kicking may excessively load and stretch the psoas and abdominal muscles. This may generate an interface problem with the ilioinguinal nerve. This crucial nerve originates from the lumbar region, travels on the lateral part of psoas and around the abdominal wall and quadratus lumborum and finally emerges at the medial part of the thigh. Due to the interface problem an irritation of the nerve develops and, as a cause and effect consequence, the groin becomes aggrivated and poor muscle control leads to weakening of the abdominal wall, poor stability of the symphysis pubis and altered adductor-abdominal synergy during explosive movement. As a result, breakdown of the groin area ensues. This may then be a plausible explanation as to why problems very often co-exist with ongoing groin pain.

Presentation and diagnosis

History

'It is important to remember that groin problems often have more than one possible pathology existing'

An athlete presenting with an adductor strain/tear will usually remember a definite episode leading to the injury, whether caused by sprinting, turning, stepping or kicking. Usually immediate pain is felt in the adductor attachment or in the two to three centimetres below the attachment. The athlete will demonstrate some degree of functional difficulty, whether it be inability to sprint or kick, and even walking may be hindered.

Often the adductor episode is preceded by abdominal or groin pain in the weeks leading up to the injury. For example, a posterior abdominal wall weakness may cause initial pain in the lower abdominal and/or referred into the groin. As mentioned above, due to possible reflex pathways the abdominal pain may then cause spasm and increased tone in the adductor group, leading to tightness and subsequent tearing.

Strength testing

The best way to test strength and inhibition of the adductor muscles is through the 'Adductor Squeeze' test. *This is done with the athlete lying on the table with the legs extended*. The examiner places two clenched fists together between the athlete's knees and the athlete then squeezes the knees onto

the examiner's fists. With acute injuries, it is advisable that the athlete is instructed to slowly build pressure until maximum pressure is achieved. Pain and inhibition are then subjectively assessed. The same test is then done with *the feet up on the table and the knees bent to 45 degrees*. The third and final position is *feet off bench with hips at 90 degrees*. It is necessary to test all three positions, as acute tears may actually be pain-free in one of these testing positions.

The purpose of these tests is to qualify pain and inhibition at all testing positions and to gain some 'asterix' points for re-assessment in the near future.

How does the area feel?

It is important to gain an impression of where the majority of tenderness exists. When felt the adductor tubercle (at the upper inside part of the thigh) is in most healthy people usually tender. Do not confuse tenderness in this point as direct evidence of the source of the pain. Compare sides and qualify that the pain and tenderness correlates with the pain felt on functional movements and adductor squeezes. Carry on and palpate (feel & assess) the entire upper adductor muscle bellies (longus, brevis, magnus, gracilis, pectineus) for areas of tenderness, accumulated swelling and obvious defects or soft tissue abnormalities. Continue down the entire muscle feeling for reactive spasm and trigger points. Finally, don't forget to get your athlete to turn over and feel the fibres on the back of the adductor magnus.

'Assessing hip joint internal rotation is probably the most important and significant rotation direction to feel in relation to adductor problems'

Associated joints

The hip joint, lumbar spine and sacroiliac joints (SIJ) are all related via the kinematic chain to the groin area.

Hip joint

Assessing hip joint internal rotation is probably the most important and significant rotation direction to feel in relation to adductor problems, measuring internal rotation in both 90 degrees flexion and prone (lying face down) hip neutral.

Rotation at 90 degrees is the more important range to gauge when dealing with adductor problems.

Decreased internal rotation is a common finding in athletes with osteitis pubis, inguinal hernias and lumbar spine pathologies. Lack of internal rotation may lead to a compensatory increase in hip abduction with stepping and cutting manoeuvres. This may then lead to excessive force being placed on to the adductor muscles and an injury may result.

Lumbar spine

Lumbar spine mechanics may have a complex and important role in the development of adductor-muscle problems. Ultimately this may lead to extra stress being directed at the hip flexors and adductors while sprinting and kicking. This coupled with poor lower abdominal control of the pelvic girdle may then lead to poor force transfer from the thigh, across the pelvis and into the trunk.

It is interesting to note how often athletes complain of a tight and restricted lumbar spine (usually only one side and more often the left) in the few days preceding an adductor muscle tear. This is purely an observed clinical finding and has no empirical evidence based backing. One could rationalise that a tight and restricted lower lumbar spine may then cause a relative increase in hip joint movement that places more force on the unprepared adductor muscles. It is also interesting that clinical observation suggests that most of this occurs on the left side. It is a common finding, that the most prevalent pelvic pattern is to have a hypertonic (in a state of abnormally high tension) right TFL (tenor fasicae latae) and psoas and a hypertonic left gluteus medius and gracilis. This is not to suggest that the majority of adductor tears are left-sided. However, in my experience, the balance is certainly not 50-50 left and right.

Sacroiliac joint

For the same reasons mentioned above, a restricted SIJ (sacro-iliac joint) may cause a compensatory increase in motion

required at the hip joint and adductor region. Exponents from the osteopathic school of thought will highlight how often a tight and restricted SIJ glide will precede an adductor muscle tear on the opposite side. Again, the complex interplay of all the joints making up the kinematic chain must be addressed.

Abdominal control

Controlling movement of the lumbar spine and pelvis is an essential component in providing a solid base from which the thigh muscles can function. Good activation and patterning of the deep stabilising muscles and the superficial 'core' muscles will reduce stress on the spine and minimise unwanted transfer of stress to the thigh muscles.

It is interesting to note that the Australian Rules Football Medical Committee is currently undertaking a large cohort study on the role Transversus Abdominus (TrA) has in the development of osteitis pubis. The biomechanical rationale is that poor TrA function leads to poor closure of the symphysis pubis during movement and thus the symphysis is subject to more shear force and subsequent breakdown. The role this has on the development of groin tears is more difficult to deduce.

Chris Mallac

Practical Treatment for Groin Injuries

Chris Mallac *discusses practical treatment of the groin injury*

Immediate management

Immediate icing of direct muscle tears of the groin and especially adductor attachment tears is beneficial and necessary in the 24-hour period after the injury. Unlike hamstring injuries, however, movement while icing is not necessary and may in fact be detrimental to the turn-around time of adductor injuries. This will be expanded further in the section on stretching.

Soft-tissue therapy

Any therapy that reduces muscle tone in the adductor muscles will be a useful adjunct in the treatment of this injury. This may be any soft-tissue massage in the area below the tear or 'trigger point' injection therapy into the adductor muscle belly.

Groin straps

It is common practice in Australia (particularly the Rugby League haven of New South Wales) to use groin straps in the management of adductor lesions.

The rationale behind the adductor (groin) strap is similar to the Chopart or patella tendon strap. The application of the strap directs force on to the strap and away from the injured tissue. In relation to the adductors, the strap is usually applied high up around the thigh as close to the adductor tubercle (bony prominence on the upper inside part of the femur) as possible. It is placed on quite tight to be supportive but not occlusive to the femoral artery, vein and nerves. This then

takes stress away from the adductor tubercle. It will result in an immediate decrease (not abolition) in pain on functional movement and adductor squeeze testing.

The athlete is instructed to keep the strap in situ 24/7, except for showering and sleeping (however, there is no reason why it needs to be removed during sleep). The athlete can continue to wear the strap during rehabilitation and return to sport.

Stretching

For some strange reason, the adductor muscles (and Tensor Fascia Latae for that matter) are the only muscles that respond POORLY to stretching in the initial post-injury period. There is no plausible explanation for this phenomenon. One possible reason (and this reason does have its flaws) is that the adductor muscle does not operate through a large range of motion during the execution of most sporting manoeuvres. Therefore, stretching of the muscle into end-of-range positions in the initial period may in fact place the muscle in a position it is not used to and comfortable with. This may lead to an adverse tissue reaction that further adds to the stress of the muscle and results in further increases in muscle tone.

The alternative to stretching the adductor muscle group is to use 'isometric (muscle contracts, but does not change in length) stretching'. This is done by squeezing a football, rugby ball or netball. The ball is placed between the knees in the three testing positions (highlighted in the previous article 'rehabilitation for the groin injury' by myself). The ball is then squeezed to the point of discomfort but not pain. The contraction is held for 10 seconds and the legs are then moved up to the next position, 45-degrees knee flexion. Again, this is held for 10 seconds and the legs are then lifted to the 90-degree hip flexion position and contraction repeated for 10 seconds. Back down to legs straight and start again. This can be done five times in each position.

Why it works

The theory behind isometric stretching of the adductors is as follows. As the muscle isometrically contracts against a stationary

and non-deformable object (the ball), the muscle tissue will undergo a degree of shortening. As a consequence, the tendon attached closest to the muscle will be required to elongate slightly to keep the entire muscle-tendon complex at the same length. The amount of stretch and elongation we are talking is tiny; however, it is enough to cause a slight elongation in the tendon and tenoperiosteal junction (where tendon attaches to bone). No other muscle in and around the pelvis responds in the same way to this technique as the adductor muscles.

Another way to isometrically stretch is to have your partner control the weight of the leg, which is in knee extension. The leg is then lifted into progressive degrees of hip flexion, abduction and internal or external rotation. You will then be instructed to gently pull into the opposite direction (adduction, flexion and the other rotation). This is very similar to a PNF contract-relax stretch. The leg can then be lifted and placed into more progressive positions, but unless clinically trained it is important to air on the side of caution.

Strength retraining

Initial strength retraining may take the form of 'adductor squeezing' as described above. This can be started almost at day one. The act of performing the adductor squeeze thus serves two functions; isometric stretch and strength retraining. This can be progressed from supine lying positions to wall squat positions. The protocol is the same: aim for 10-second holds and attempt five repetitions in each position. As adductor squeeze and function improves, the following exercises may be added to strengthen the adductor muscle:

Theraband adductions (crook lying): lying supine (on back) with knees and hips bent to 45 degrees. Place theraband around knee and attach to leg of table. Let the leg fall out to position of abduction and contract back to knees together position. This can be progressed into greater range, greater speed and greater resistance.

Theraband adductions (standing): standing with theraband around heel, hold on to chair for support, allow band to pull leg

into abduction, contract back to adduction. Perform with the foot in front of the stance leg and foot behind the stance leg. And very important, do both legs. The adductor needs to retrain its movement function as well as its stabilising function.

Lunging (around the clock): feet together, step out in front (12 o'clock) and take weight via a lunge action. Push back to start position. Step out to the side (3 or 9 o'clock position) and back, then step backwards (6 o'clock) and back. Again, do BOTH legs.

Lateral step ups: place a knee-height box or chair about three feet at your side. Step up on to the box sideways and down again. Again do both legs. Progress by increasing speed.

Swiss ball squats: on a Swiss ball, either stand (for the vertically challenged) or perform a partial squat. This is a great isometric-adductor strength exercise.

Weights: this is not the time or the place to discuss weight-training routines, but a few key principles regarding leg weights need to be laid down. First, perform and be happy with two-legged bilateral exercises before progressing to one-leg unilateral exercises. For example, do two-legged leg press before attempting one-legged leg press. Second, be careful with the progression of load and speed. Adductors tend to work exponentially harder as one approaches the one repetition maximums. Respect this before progressing loads. Furthermore, ballistic movements such as power cleans and snatches tend to recruit more adductor activity. Exercises where the feet do not leave the floor are generally safer initially.

Functional strengthening: field activities such as side-stepping and cariocas.

Rehab running/training

This stage has similar progressions to the fitness testing mentioned below. In order to retrain the adductors for functional use, activities need to be presented in a logical and progressive order.

The stages can be progressed from one day to the next, or progressed within the same session depending on presentation of symptoms. The progressions are as follows:

Straight line running: distances can be progressed in pyramid fashion. That is, 10m, 20m, 30m, 40m and so on. Overall maximum distance will depend on the individual athlete's requirements (sport and position). Speed needs to be progressed sensibly and always on the basis of presenting symptoms (pain) and clinical signs (adductor squeeze and palpation). Aim to reach full top-end speed before reaching flat-out acceleration and deceleration.

Weave running: progressed as above but instead of in a straight line, the athlete runs curves.

Sideways shuttles: stand on a line. Sidestep five times to the right and then sprint forward 10 metres. Rapidly stop and then side-step five times to the left. Sprint 10 metres again and repeat the process to the right. This can continue for as many 10- metre segments as desired.

Sprint and cut: sprint forward 20 metres and step rapidly to the left at a 45-degree angle. Walk back and repeat to the right.

Cone drills: place five cones out in a random order over a 10-x-10- metre square. The idea of this drill is for the athlete to sprint to one cone, rapidly stop and reach down to touch the cone, look up at the tester who points at another cone for the athlete to sprint towards. This continues for 20 seconds and can be repeated as many times as desired.

Functional skills: depending on the sport played, this would include (if relevant) kicking, scrums, tackling, jumping etc..

Fitness testing

Those involved with the management of groin injuries (physiotherapists, sports medicine physicians, orthopods and athletic trainers) all have their favourite ways of assessing fitness for competition. Outlined below is a very direct and accurate method of assessing the functional ability to perform in competition and avoid risk of re-injury following an adductor-muscle strain.

The premise of the following fitness testing protocol is that two criteria must be satisfied; first, that the athlete can perform the testing procedure pain-free and without functional

limitation, and second, that the adductor muscle does not 'tone up' two to three hours following fitness testing. This is assessed by palpation of the muscle. It is common for athletes to able to complete such a fitness testing session, and then have all sorts of problems in the few hours following.

As far as timing goes, this type of testing can be done the day before competition or even on the morning of an afternoon competition. This is in contrast to hamstring muscle injuries that ideally should be fitness tested 48 hours prior to competition.

Procedure

Assess adductor squeeze (pain and weakness) at three testing positions and feel muscle tone to gain an initial baseline. These should feel good if you have progressed to fitness testing.

Ten minutes of general running and stretching

Straight line running: 5 x 40 metre runthroughs progressed from warm-up speed to full speed. The rate of acceleration is not important at this point; the focus is on reaching full speed before 40 metres. Walk return after each repetition.

Straight line acceleration: (over 20 metres): 1 x 20 metre flying start (jog in before flat-out acceleration); 1 x 20 metre upright start (off the mark); 1 x 20 metre 3-point stance start; 1 x 20 metre starting on stomach.

Weave running: 4 x 40m: running in a 5-10 metre channel, the athlete sprints whilst weaving between two parallel lines (the in-goal area of a Rugby pitch is ideal). This is a pure weave (similar to running around a curve) and no side-stepping is involved. For example, the athlete may be instructed to touch the right line and then left line twice each on the first run, three times on the second, and so on. By increasing the number of touches on each line, the angles involved in the weave will become more acute and more challenging for the groin muscles.

Cutting manoeuvres: sprint 20 metres straight line and cut (stepping off) 45 degrees to the left or right (at full speed) and continue to sprint for another 10 metres before decelerating. Complete two to the left and two to the right.

Cone drills: place five cones out in a random order over a 10-x-10-metre square. The idea of this drill is for the athlete to sprint to one cone, rapidly stop and reach down to touch the cone, look up at the tester who points at another cone for the athlete to sprint towards. This continues for 20 seconds. The athlete repeats this for a total of four repetitions with one-minutes rest between efforts.

The final two efforts are modified in the following way. Instead of bending down to touch the cones, the athlete falls to the ground on his/her front. Before the athlete gets back to their feet, the assessor places some pressure on the athletes back so that they need to fight their way back on to their feet before continuing. This continues for 20 seconds (in this time expect the athlete to hit the ground 3-4 times). As a word of caution, this is very fatiguing to do at full speed for a full 20 seconds (if you disagree, try it yourself). Therefore, if testing on the morning of a game the time period may need to be modified depending on the individual fitness characteristics of the athlete/player.

'The tests should be performed pain-free and without functional limitation'

Kicking: if this is a common skill component encountered in the game. Start with short-distance kicking and progress to long kicking and kicking across the body and kicking on the run. Warm down and stretch for 10 minutes.

Re-assess adductor squeeze and muscle tone: immediately after warm down, then again 2-3 hours following fitness testing. It is important that the adductor muscle is not treated in this time period.

The above testing procedure will assess the ability to perform all physical components required for competition whether the sport is football, rugby, basketball or Australian Rules Football. The distances can be modified for court sports such as tennis, basketball and netball, and the need to assess the ability to spring off the ground is not essential for these sorts of sports.

As I mentioned earlier, the above test should be performed pain-free and without functional limitation. Examples of

functional limitation would be the inability or reluctance to turn away from the injured side, holding back on the acceleration component and obvious limping (hopefully the assessor would be wise enough to not even bother fitness testing in this situation).

The re-assessment of muscle tone is also of critical importance. If muscle tone is to increase following such an intense and involved testing session, then it will do so within the first two to three hours following the testing. An increase in muscle tone is an indication that the original source of the problem has been irritated and has 'driven' the tone in the involved muscle belly. This is an important indication that the muscle is subject to possible further damage (in the form of a strain) especially under fatigue. The increase in tone will be quite obvious when you feel the area especially if you have been assessing tone on a regular basis during days running up to the fitness tests.

- Groin/Pelvic Pathologies
- Adductor muscle tears (Grade 1-3) (Add Brevis, Add Longus, Gracilis)
- Adductor Tendonitis/ Tenoperiostitis
- Osteitis Pubis (Pubic Symphysitis)
- Inguinal/Sportsman's Hernia
- Posterior wall insufficiency
- Conjoined tendon tear
- Ilioinguinal nerve irritation
- Iliopsoas strain/bursitis
- Stress fracture (pubic ramus)
- Referred pain (lumbar spine and sacroiliac joint)
- Obturator nerve neuropathy
- Sinister pathologies such as prostatitis, UTIs, testicular tumour, infection.

Chris Mallac

A new take on gluteus medius

It's time to take another look at the gluteus medius muscle. You may wonder whether there is anything more that can be said – so read on and prepare to be surprised. The fact is that the basic function of the gluteus medius has not been truly appreciated in the sports medicine literature. This article is going to try to address the gap.

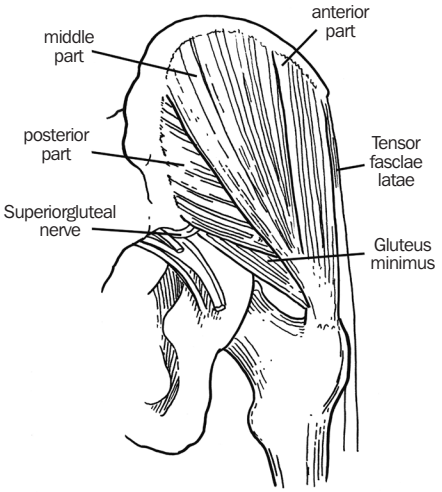
Gluteus medius plays an important role as a strong hip abductor and the major stabiliser of the pelvis on the weight-bearing femur during stance phase of gait. It prevents the hip on the opposite side from 'dipping' during single-leg stance (otherwise known to sports medicine professionals as a positive 'Trendelenburg sign'). However, this small but valuable muscle has a more extensive role to play, and understanding the intricacies and how to get the most out of it, should therefore be a priority of every coach and their athlete.

What gluteus medius really does

The most significant anatomical and functional study to date conducted on the gluteus medius muscle was undertaken by Gottschalk et al in 1989[1]. From their anatomical dissection studies, they suggested that the gluteus medius attaches to the outer edge of the iliac crest (top of the hip), starting at the anterior superior iliac spine (ASIS) and extending all the way to the posterior superior iliac spine (PSIS).

The gluteus medius attaches to the top centimetre of the iliac crest but not to the blade of the ilium. It runs downwards in a fan shape and attaches to the antero-superior (upper front) aspect of the greater trochanter (outside of the femur), and not to the lateral aspect of the trochanter, as is sometimes

Figure 1: Gluteus medius fibres



Source: Gottschalk et al 'The functional anatomy of tensor fascia latae and gluteus medius and minimus'. Journal of Anatomy. 166: 179-189.

incorrectly outlined in anatomy textbooks. This is important to note, as the attachment allows the tendon to contribute to anterior (front) hip stability when the hip is in an extended position (*see Figure 1*).

The muscle is divided into three equal components: anterior (front), middle and posterior (back). The fibres of the posterior portion run almost parallel with the neck of the femur, while the middle and anterior parts run vertically from the iliac crest to the antero-superior (front and upper) aspect of the greater trochanter.

Each of the three parts of gluteus medius has its own nerve supply running from the superior gluteal nerve, suggesting that the muscle actions of the three heads are independent of each other.

Gottschalk et al reported their EMG study findings that gluteus medius is not all that active in isolated abduction of the hip. This finding may well surprise you, as it is contrary to what has been taught for years in anatomy and biomechanics lectures and textbooks. They observed that the tensor fascia lata (TFL) is significantly active in isolated hip abduction.

When researching the stance phase of gait, they went on to suggest the front portion of the muscle (which is anatomically similar to the TFL) is most active at full stance and single-leg support phase, while the rear fibres fire strongly at initial heel strike.

Gottschalk et al suggested that the main role of the gluteus medius is to compress the head of the femur into the acetabulum (hip socket) during movement. They then put forward the notion that each of the three distinct heads of the muscle performs a unique role as the body moves:

The posterior fibres contract at early stance phase to lock the ball into the hip socket. The posterior fibres therefore essentially perform a stabilising or compressing function for the hip joint.

The middle/anterior fibres, which run in a vertical direction, help to initiate hip abduction, which is then completed by the TFL. These fibres work synergistically with TFL in stabilising the pelvis on the femur, to prevent the other side dropping (or Trendelenburg).

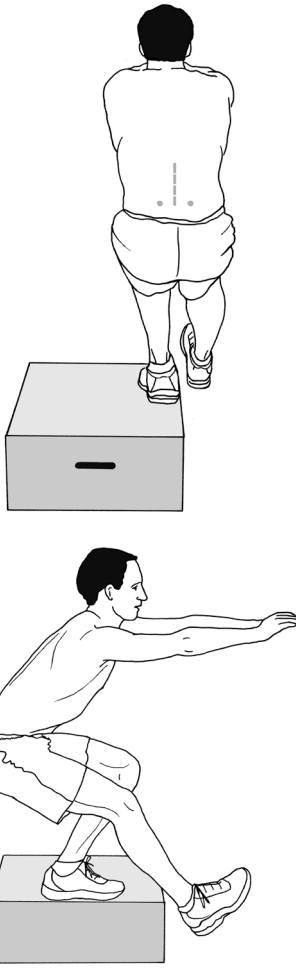
The anterior fibres allow the femur to internally rotate in relation to the hip joint at mid-to-end stance phase. This is essential for pelvic rotation, so that the opposite side leg can swing forward during gait. The anterior fibres perform this role with TFL.

So Gottschalk et al believed that the primary functions of the gluteus medius are:

- to stabilise the hip
- to act as hip rotators
- to approximate the head of the femur into the acetabulum, in effect creating a very tight and stable hip joint during gait.

This prevents the ball and socket joint from rattling around during walking and running, similar to how the rotator cuff muscles in the shoulder work to produce a tight and stable glenohumeral joint during arm elevation.

Figure 2: The single-leg squat



How to assess gluteus medius function

1. The single-leg squat *(see Figure 2)*

The main purpose of the single-leg squat is functionally to evaluate the dynamic quality of single-leg support as part of a kinetic chain from the foot to the trunk. It is always wrong to ignore a poor single-leg squat, as this movement shows you

Table 1: Single-leg squat assessment prompt sheet

Musculoskeletal issue	Observed compensations	Corrective measures
Excessive and uncompensated	Pronation leading to tibial internal rotation	If client normally wears orthotics then mid-foot pronation re-assess using orthotics or a towel wedge
Reduced ankle dorsiflexion	Midfoot pronation leads to tibial internal rotation	One-inch heel block to eliminate and makes support leg appear to 'drop' inwards dorsiflexion restrictions
Knee pathology, eg	Increased inclination of trunk	Teach correct alignment and posture to a patella tendinopathy hip flexion) to move centre of mass directly more vertical position. If this increases knee over knee joint – reduces quads activation pain, knee may be a limiting factor
Poor knee proprioception	Increased hip and knee flexion to lower	Allow one-finger balance on supporting centre of gravity – increases ability to balance structure and re-assess the squat. If much improved, balance may be a limiting factor
Weak gluteus medius	Opposite side hip drops and/ or lateral	Provide visual feedback (mirror or video) to trunk flexion over the supporting foot allow correction. If gluteus medius is truly weak, poor pattern will continue
Tight hip external rotators	Pelvis on non-support side will rotate	Stretch/massage hip rotators and re-assess backwards to reduce 'stretch' on hip rotators
Tight medial hamstrings and	Starts with neutral pelvic tilt and moves	Trigger/massage/stretch hamstrings adductor magnus towards excessive posterior pelvic tilt at and re-assess 60-70 degrees hip flexion

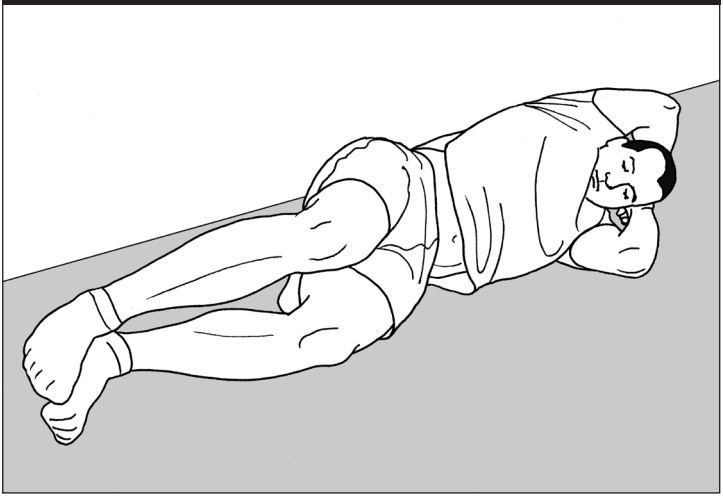
what will happen with the support leg during running.

Technique:

- Begin the movement by flexing at the hip and continue bending the knee and ankle until your thigh is parallel to the ground.
- Keep hands in front of the body.
- Keep trunk as upright as possible, preferably neck above toes, avoiding excessive lumbar and thoracic curvature.
- Heel must stay in contact with the ground at all times.

There are a few musculoskeletal structures that contribute to poor single-leg squatting, and weak gluteus medius activity is

Figure 3: The clam test

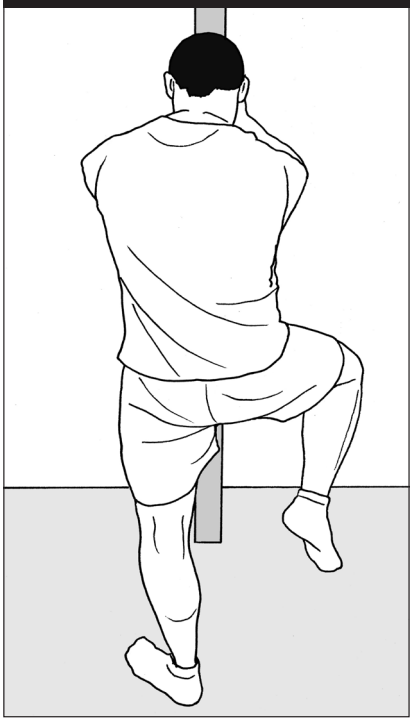


just one factor. Table 1 highlights some of these musculoskeletal issues. Therefore, if as a coach or athlete you observe or execute a poor single-leg squat, the problem will need to be address and a specific plan undertaken, with further tests (as detailed here) carried out to clarify that the imbalance has been resolved.

2. The Clam test *(see Figure 3)*
Technique:
- In side-lying, bend knees and hips to 30 degrees and align the ankles and knees.
- Slowly part the knees, ankles still touching, until they separate by 2-3in to allow the uppermost thigh to go slightly past horizontal.
- Bring the knee back to its starting position under control.

It is useful to have a partner/coach watch or feel what the pelvis is doing during this movement. Some common 'cheating' movements are:
Hip hitch: overactivity of trunk lateral flexors such as the quadratus lumborum. The QL 'helps' the pelvis to lift to make

Figure 4: Tai Bo exercise



the gluteus medius appear to be causing the movement.

Posterior pelvic rotation: pelvis rotates backwards to force the femur into a horizontal position. This occurs as the gluteus medius reaches a physiologically shortened position and can no longer produce enough tension to cause the femur to lift and rotate.

Anterior pelvic rotation: the result of overactivity of the TFL.

To date, the clam test is probably the best test to assess isolated function of the posterior fibres of the gluteus medius. It assesses the muscle's ability to slightly externally rotate and abduct the non-weight-bearing hip. It does not, however, assess the ability of the muscle to contract and approximate the hip joint to create a stable ball-and-socket joint. We will have to wait for the researchers to come up with a clinical test that assesses the hip closure role of gluteus medius.

Rehabilitation exercises

There is no shortage of source materials to find exercises for retraining gluteus medius function. Some exercises, such as isolated hip abduction in side lying, completely disregard the all-important function outlined above, of hip joint approximation/closure and pelvic stabilisation and rotation.

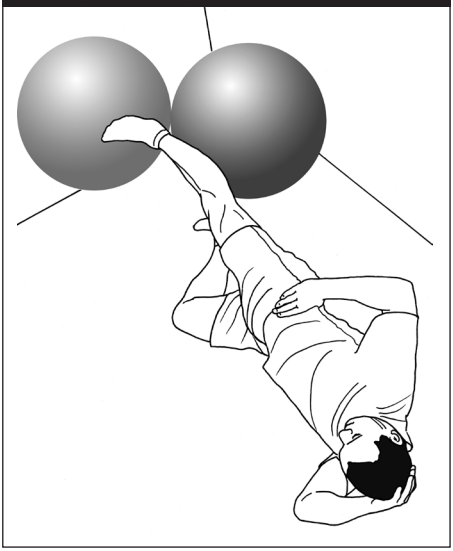
The three exercises below are particular favourites of mine. The distinguishing features of all three are:

- they are performed in weight-bearing or simulated weight-bearing
- they are performed in neutral hip position or positions of slight hip extension (most glute med exercises are done in positions of hip flexion, which tends to preferentially recruit the TFL in a hip abduction or hip stabilisation role).

Tai Bo exercise *(see figure 4 left)*
Technique:

- Stand upright with feet externally rotated to 30 degrees.
- Place one foot behind the knee of the other leg (swing leg behind stance leg).
- Make a knee bend on stance leg to 30 degrees and then, as you extend the knee again, move the swing or floating leg into flexion and abduction. Hold the position for 1 second before returning to start position. You should feel the posterior fibres of gluteus medius contract at the top of the movement.

Figure 5: Double ball wrestle



Double ball wrestle *(see figure 5)*
Technique:

- Side lie with uppermost leg in a neutral extended position, foot resting against a Swiss ball, and calf touching a second Swiss ball.
- Externally rotate the hip 30 degrees and push foot into the first Swiss ball.
- Keeping the foot pushed in, press the calf against the second ball and slowly raise both balls up along the wall a few inches. Hold the position.
- Lower and repeat.

Figure 6: Corner drill

Corner drill *(see figure 6)*
Figure 6: Corner drill to be added
Technique:

- Stand with feet in split stance, forward leg bent and rear leg extended at the hip.

● Place foot of extended leg into the corner of the room, toes about 15cm off the floor. Push foot backwards and sidewards into both walls.
● Keep upper body perfectly straight with hands on hips. You should feel contraction in gluteus medius in both stance leg and push leg.

Conclusion

Gottschalk et al in 1989 highlighted that the muscle that is most responsible for balancing the body and pelvis on the weight-bearing limb during walking is the TFL. The gluteus medius is divided into three parts with separate nerve innervations that suggest it has a phasic action stabilising the hip joint of the stance leg during the stance phase of gait.

Caution should be taken when interpreting the results of a single-leg squat assessment test. You need to think about whether it is poor gluteus medius function, or failure of another component of the kinetic chain?

Chris Mallac and Dirk Spits

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1. Gottschalk F, Kourosh S and Leveau B (1989) 'The functional anatomy of tensor fascia latae and gluteus medius and minimus'. Journal of Anatomy. 166: 179-189.

These are valuable exercises for strengthening the gluteal muscles

Why athletes must strengthen gluteus medius to prevent hip and groin injuries

Gluteus medius is a major stabiliser of the pelvis and it prevents the hip on the opposite side from 'dipping' during single-leg stance. Both these factors are key to good biomechanical function and therefore preventing injury, especially in the hip, groin and lower back.

Groin Injuries

The groin muscles anchor points for attachment are the pelvis, therefore if the pelvis tilts or moves in any direction the groin muscles are likely to suffer. This can be in the form of tightness, or weakness and this type of dysfunction can lead to injury. It is therefore vital that these anchor points for the groin muscles are kept stable by strengthening the stabilsers of the pelvis.

Hip Injuries

Equally, too much movement around the hip joint (through instability of the pelvis) will effect the hip joints function. In addition, this instability creates dysfunction in the muscles that are meant to hold the hip joint in position and the hip will be under increasing preasure and strain. This again leading to the possiblilty of injury if the core problem (the pelvis) is not addressed.

Core-stability programmes tend to focus on the trunk muscles (transversus, multifidus, obliques and paraspinals); however,

the gluteal muscles are also very important for core stability and preventing low back pain. This article will explain the functional role of the gluteals in stabilising the lumbarpelvic area and then describe a series of exercises for them.

The gluteals are a group of muscles that make up the bum area, called the gluteus maximus, medius and minimus. In anatomical terms the gluteus maximus is a hip extensor muscle (pulling the leg back) and the medius and minimus are hip abductor muscles (pulling the leg up to the side). However, for the purposes of injury prevention and improving stability, the function of the gluteals is to stabilise the pelvis and trunk and not to move the legs.

Stabilisers and mobilisers

Hides et al. (1996) and Comerford (1999) have proposed the categorisation system of stabiliser and mobiliser muscles which depicts the key differences in how each set of muscles act during functional movements.

'Mobiliser muscles act to move a limb or the trunk. They tend to act at specific times with concentric actions or stretch-shorten cycle (plyometric) actions and the muscle activity tends to be at a high level'

Mobiliser muscles act to move a limb or the trunk. They tend to act at specific times with concentric actions or stretch-shorten cycle (plyometric) actions and the muscle activity tends to be at a high level. For example, during running the hamstrings are one of the main mobiliser muscles which concentrically contract during the latter half of the stance phase at a high level to extend the hip joint to produce a push off.

Stabiliser muscles act to control the motion of a limb or the trunk. They tend to act more continuously either in a "quasi-static" manner or with a controlling eccentric pull.

The muscle activity tends to be at a low level. For example, during running the gluteus maximus acts to maintain upright posture and laterally rotate the femur as the leg pushes off, helping to achieve the toe-off position. The medius and minimus work to maintain a level pelvis when weight-bearing on one leg, preventing the free side from dropping down. They also control the rotation of the pelvis as the free leg swings forward. These are not muscle actions at a specific time which produce a movement but more of a continuous activity to maintain the optimal pelvic position.

Training "movements" and "positions"

From the example of running, it can be seen that during any functional task the muscles work in different types of ways to perform different roles. This is true of any activity of daily living (ADL), such as vacuum cleaning or picking up boxes, and athletic movements, such as jumping or swinging a golf club. These different muscles must work together in a co-ordinated fashion, with the strong mobiliser muscles powerfully contracting through the full range of motion and the stabiliser muscles switching on at the right times to control the joint positions.

This is the key difference between functional tasks and exercises where muscle groups work in isolation and explains why the mobiliser/stabiliser system is so important to understand. For effective core stability and injury prevention one must train "movements" and "positions" rather than "muscles". By this I mean that exercises are more effective when they mirror the demands of ADL's or athletic movements. It is possible to perform exercises which isolate the gluteus maximus (eg leg extensions) and gluteus medius and minimus (eg hip abductions), but this is not how these muscle act in reality.

'When designing training programmes to improve muscle function, it is easier to think in terms of the mobiliser/stabiliser system as it guides us into using exercises that will be more functional'

When designing training programmes to improve muscle function, it is easier to think in terms of the mobiliser/stabiliser system as it guides us into using exercises that will be more functional. The system tells us that stabiliser muscles need to switch on easily at low-load levels, they need to be able to maintain joint position and they need to have good endurance. Stabiliser muscles tend to become inhibited and are not active enough for sufficient duration. Therefore to train stabiliser muscles correctly, exercises should involve positions that mirror ADL or athletic movements, they should be trained with light loads and many repetitions or made to hold the correct position for a prolonged period.

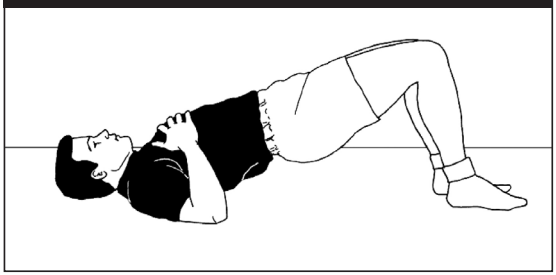
Here are descriptions of how the gluteal muscles fail to act efficiently as stabiliser muscles and the corresponding exercises to improve these dysfunctions. By targeting the lack of stability in this functional manner the results of the training programme will be more effective.

Exercises for common gluteal muscle dysfunction

One of the most common problems with the gluteal muscles is that they are not active enough during trunk flexion and extension movements. This has been shown by Leinonen et al (2000) who found the gluteus maximus was significantly shorter during a forward flexion extension movement (bending over) in back patients compared to healthy controls. This suggests that insufficient recruitment of the gluteus maximus may increase the risk of injury, which makes sense if you consider the role of the gluteus maximus, which is to help maintain an upright posture and extend the trunk.

Two exercises to improve the gluteus maximus's ability to support the extension of the spine are the "Bridge" and the "Wood Chop".

The Bridge



The Bridge

This is a static exercise where the gluteus maximus must work to support the back. Proper technique is essential if the correct stability mechanisms are to be improved.

Level 1

Lie on one's back with knees bent. Draw in the lower abdominals and curl the bum off the floor, lifting the hips until the knees, hips and chest are in line.

Hold this position, purposefully squeezing the glutes to support the bridge position. Start with 10 x 10 seconds, building up to 2 x 60 seconds.

Keep the pelvis level and the lower abdominals drawn in. If you feel a strong contraction in the hamstrings or the lower back is straining, then you are not using your glutes strongly enough. Focus on them to ensure they do the work.

Level 2

Same as above, but once the bridge is achieved lift one knee up in the air and support the bridge on one leg only. Hold for a count of two and then swap sides. Maintain for 60 seconds. Build up to 3 minutes.

Again, ensure the pelvis remains level and the lower abdominals drawn in. If you feel a strong contraction in the hamstrings then you are not using your glutes enough.

The Wood Chop

This is a dynamic exercise where the gluteals must work to extend the trunk from a flexed position.

Level 1

Stand with feet shoulder-width apart, knees slightly bent. Stand up tall and hold a weight in two hands above your head (5kg men, 3kg women).

As if you are wielding an axe to chop wood, bend from the waist and bring the weight down between your legs in a controlled manner. Do not bend your knees any further as you bend forward. At the bottom, draw in your abdominals and squeeze your glutes for support before returning to the start position. When you return upright, ensure it is with the correct sequence, extending your lower back first, then bringing your shoulders up and finally lifting the weight above your head.

Begin with 2-3 sets of 10 reps building up to 20 reps.

Level 2

Same as above, but on one leg.

Improving pelvis stability

The second common gluteal muscle dysfunction is insufficient gluteus medius and minimus activity during walking and running to maintain the correct gluteal position. Norris (1995) discusses how inhibited gluteus medius and minimus leads to

poor pelvic stability where insufficient tension during single-leg weightbearing causes the free-leg hip to drop down.

Two exercises to improve the ability of medius and minimus to maintain pelvis stability are the "Hip Hitcher" and "One-Leg Squats".

One-Leg Squats

This exercise is normally for the legs, but if performed with perfect technique it also works the medius and minimus very hard to maintain pelvic stability.

Stand on one leg in front of the mirror. Ensure your head is up and your shoulders are back, with the lower abdominals drawn in for support. Arch your foot slightly to ensure your knee is not pointing inwards.

Squat down with your bum going back and your knee staying over your laces. Keep the free-leg knee next to the stance knee to ensure you stay aligned. Keep your pelvis level and square as you squat down. Stand back up, ensuring everything remains aligned.

Build up to completing 3 sets of 10 each leg.

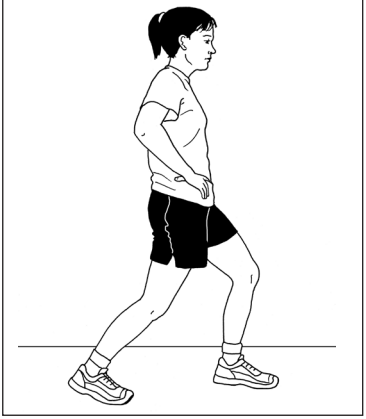
Gluteal muscle imbalance and stretching exercises

The gluteals can also be negatively affected by muscle imbalance problems with adjacent muscle groups. Muscle imbalance refers to muscles being shortened and lengthened with respect to each other. Mobiliser muscles have a tendency to shorten (become less flexible) and so are recruited more easily. This is because pre-tension in the muscle increases its excitability. As a consequence, adjacent or antagonistic muscles can become inhibited, impairing their function.

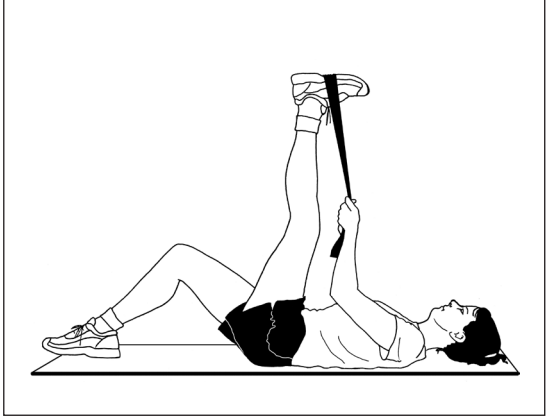
For example, inflexible hip flexors can cause an excessive anterior pelvic tilt which inhibits the gluteus maximus and tight adductors and overactive tensor fascia lata can inhibit gluteus medius and minimus.

Therefore, to ensure correct recruitment of the gluteals the surrounding mobiliser muscles of the hip must be fully flexible. A set of stretching exercises for hip flexors, hamstrings, adductors and tensor fascia lata would be useful to avoid any

Hip flexor stretch



Hamstring Stretch



imbalance problems described above. Here they are.

Hip flexor stretch

Slowly lunge forward with one foot infront of the other. Keep your upper body upright and chest high. Tilt your pelvis back, tucking in your stomach and squeezing your gluteals. You should feel the stretch in your hip flexors.

Hamstrings stretch

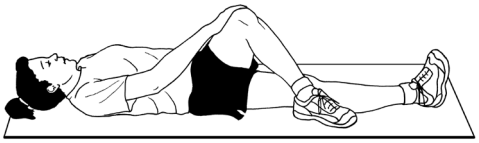
Lie on your back with your knees bent. Pull one leg up towards you (you can use a theraband or rolled towel if required) and using your quads straighten the knee as much as you can, stretching the hamstring.

Adductor stretch

Adductor stretch

Sit up with the soles of your feet together. Using your hands push your knees gently apart to the floor stretching the groin area. Sit up with legs straight out and as wide as you can get them stretching the groin. Support your body with hands behind you.

Tensor fascia lata stretch



Tensor fascia lata stretch

Lie on your back with knees bent and arms out wide. Cross your legs and use the top leg to push the bottom leg over to the side. Take your legs over until your opposite shoulder starts to come off the floor; you should feel the stretch on the outer thigh/hip area.

Raphael Brandon

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Core Stability Exercises For Transverse Abdominis and Oblique Abdominis

Why athletes must strengthen transverse abdominis and oblique abdominis to prevent hip and groin injuries

Transverse abdominis and oblique abdominis help to stabilise the pelvis. This stablility is vital for a good platform of attachment for the groin muscles and correct hip function, helping in the prevention and rehabilitation of hip and groin injuries. In addition having pelvic stability will also create biomechanical effeciency that will improve athletic perfomance.

Menu 1: Floor, static

Menu rationale

To develop a basic level of lumbar and pelvic stability, working front, rear and sidemuscles of the trunk.This menu can also be used as a maintenance dose of training for intermediate to advanced level athletes.

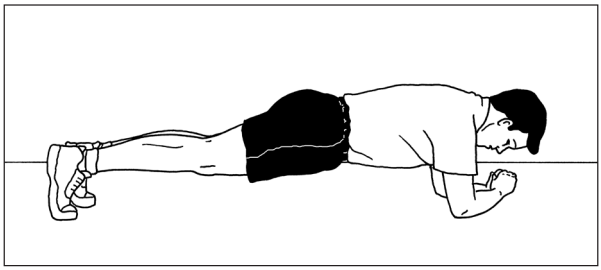
The Plank

Overview: A common exercise that requires good abdominal strength and co-contraction of the abdominal wall musculature to hold the lumbar spine and pelvis in correct alignment.

Level: Basic/intermediate

Muscles targeted: Rectus abdominis, Abdominal wall (transversus abdominis/internal obliques)

Technique: Hold a straight body position, supported on elbows and toes. Brace the abs, and set the low back in the neutral position, once you are up. Sometimes this requires a pelvic tilt

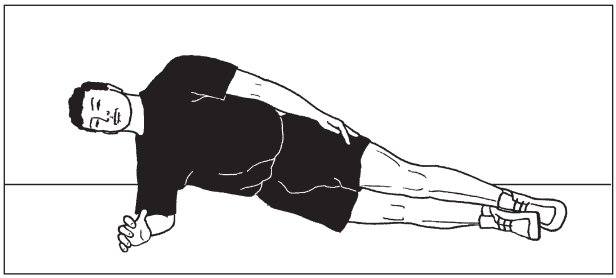


to find the right position.

The aim is to hold this position, keeping the upper spine extended, for an increasing length of time up to a maximum of 60 secs. Perform 2 to 3 sets. Keep shoulders back and chest out while maintaining the neutral lumbar position. This makes the exercise considerably more challenging.

Progression: Lift one leg just off the floor; hold the position without tilting at the pelvis.

The Side Plank



Overview: Recommended as a safe and effective exercise for the obliques and quadratus lumborum (a key lumbar stabilising muscle). Recent research also shows this to be an excellent exercise for the lower abdominal muscles.

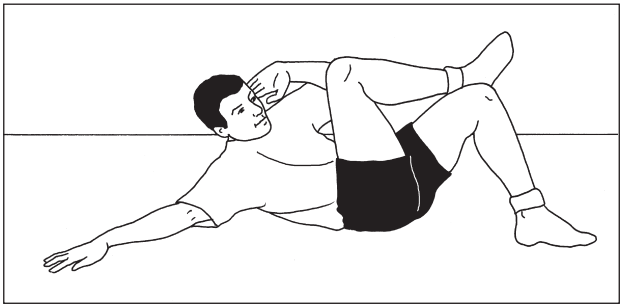
Level: Basic/intermediate

Muscles targeted: Obliques (internal and external), Quadratus lumborum, Transversus abdominis

Technique: Lie on one side, ensuring the top hip is 'stacked' above the bottom hip. Push up until there is a straight bodyline through, feet, hips and head. Hold the position, increasing the

length of hold up to a maximum of 60 secs. Perform 2 to 3 sets. Keep the elbow under the shoulder to avoid upper body strain. Lower under control and repeat on opposite side.
Progression: Raise the top leg in the air and hold it in that position throughout.

Oblique Crunch



Overview: A good exercise for both the obliques and the abdominals.
Level: Intermediate
Muscles targeted: Rectus abdominis, Obliques
Technique: Lie on your back with right ankle resting on left knee. Right arm is placed on the floor out to the side. Keeping the right shoulder down, curl the left shoulder up to the right knee. Crunch at the top and return slowly, under control. Perform sets of 15 to 30 reps on each side in turn. Avoid 'head nodding' during the movement: keep head off the floor and look forward throughout.
Progression: Hold a dumb-bell in the hand by your head. Keep arm still so you are forced to raise the dumbell using your abs and not your arm.

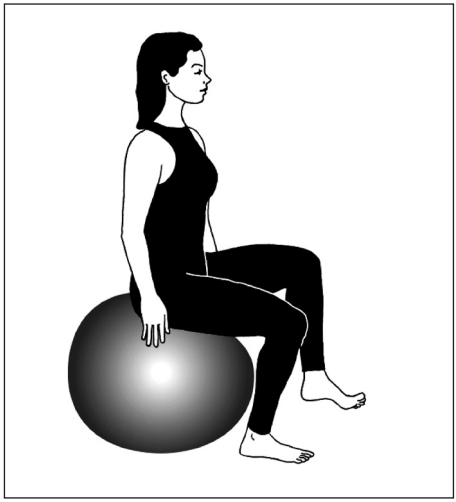
Lying Windscreen Wipers

Overview: An advanced active mobility exercise working the obliques and trunk rotation.
Level: Advanced
Muscles targeted: Rectus abdominis, Obliques

Technique: Lie on your back with arms out to the sides. Lift legs straight up in the air until the hip is at 90 degrees. Set the lumbar spine in neutral and aim to keep it set throughout. Keeping legs straight and maintaining hip angle, move the legs to one side, controlling any movement in the trunk. Go as far as you can in control, keeping your upper back and shoulders on the floor.

Bring the legs to a halt, pull them back up to the start position and then over to the other side, under control. The slowside-toside movement like a 'windscreen wiper' arc.

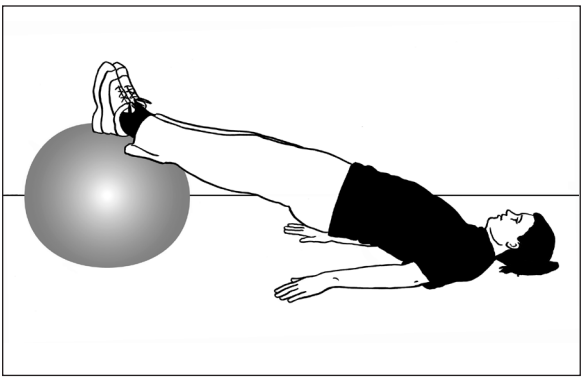
Swiss Ball Sit and Leg Lift



Overview: Challenges your ability to co-contract the abdominal wall and maintain a neutral lumbar spine position on an unstable seat.
Level: Basic
Muscles targeted: Abdominal wall (transversus abdominis, internal obliques)
Technique: Sit on a Swiss ball with hips on the top of the ball and feet hip-width apart. Ensure the size of ball is correct: your knees should be level with or slightly lower than your hips and

at 90 degrees in sitting. Relax and find a neutral lumbar spine position. Set this position by lightly bracing your abdominal muscles. Think about good upper back and shoulder posture as you sit (stomach in, chest lifted, shoulders low and relaxed). It is important to hold an upright sitting position – not leaning forward or back. Once you are set, carefully lift one foot a few centimetres off the floor. Maintain your balance, lumbar and pelvic alignments as you hold the position on one leg. Hold for a count of 5 to 10, maintaining form. Perform 5 reps each side.
Progression: Keeping the lifted foot only just off the floor, straighten the leg in front of you, stretching the hamstring. Resist any tilting of your pelvis as the leg straightens by keeping a good hold of the abdominals and maintaining posture against the stretch.

Supine Swiss Ball Bridge



Overview: A posterior-chain exercise (hamstrings, gluteals and back), where the aim is to hold perfectly straight hip and back alignment against the load of your bodyweight and the instability of the ball. A big co-contraction of the trunk muscles is required to perform this exercise well.
Level: Intermediate
Muscles targeted: Gluteals, Hamstrings, Erector spinae, Abdominals, Obliques
Technique: Lie on your back with heels on the top of the Swiss

ball, hip-width apart to aid stability. Suck in the abs and squeeze up from your gluteals, lifting your hips until there is a straight line from heels to upper back. Shoulders and head stay firmly on the floor. Take care not to lift the hips too high or flare the ribs so that your back hyperextends.

Hold for 30 seconds and lower under control. Perform 2 to 3 sets.

Progression:

i. Place the feet close together on the ball to increase the balance challenge as you lift your hips.

ii. Roll your legs slowly from side to side with control, keeping hips up for an advanced level of challenge.

Swiss Ball Gluteal Bridge

Overview: A second posterior-chain exercise. But with the knees bent and the weight bearing down through the feet, the work is felt mainly in the gluteal muscles

Level: Intermediate

Muscles targeted: Gluteals, Erector spinae, Abdominals Obliques

Technique: Lie on your back with your shoulders and head on the top of a Swiss ball; feet on the ground, hip-width apart for stability. Squeezing up from the gluteals, lift hips until there is a straight line running through the knees, hips and shoulders. Do not lift the hips too high or flare the ribs so that your back hyperextends. Hold for 30 seconds and lower under control. Perform 2 to 3 sets.

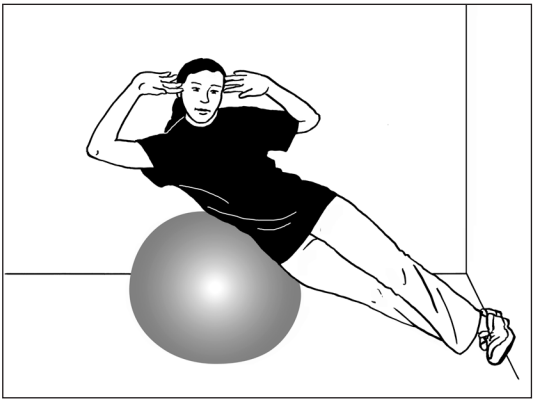
Progression:

i. Place the feet close together to increase the balance challenge.

ii. Single-leg bridge, alternating legs with 5 second holds, is an advanced challenge.

Swiss Ball Side Crunch

Overview: An excellent exercise for the obliques. The Swiss ball simply replaces the need for a frame or partner support for your legs. Electromyography research has shown this exercise

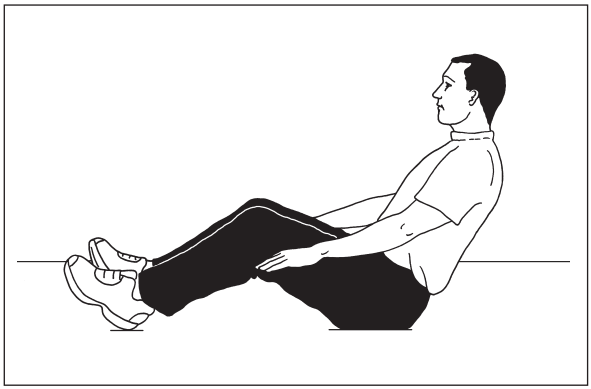


delivers high recruitment levels of the obliques.
Level: Intermediate
Muscles targeted: Obliques
Technique: Position yourself sideways on the ball, balanced on lower hip with top hip stacked
vertically. Brace feet against a wall, one slightly in front of the other for stability. Ensure a straight line through legs, hips and shoulders. Place your hands, elbows bent, by your head.

Lift upper body up away from the ball, crunching sideways towards your feet and focusing upon your oblique muscles. Slowly return, under control. Perform 10 reps, increasing to 20 reps; 2 to 3 sets.
Progression: Hold a weight across your chest to increase the load.

Medicine Ball
45-degree Sit, Catch and Pass

Overview: A very tough stability exercise that requires massive trunk musculature co-contraction to hold a good spine alignment against the impact of making the catch.
Level: Advanced
Muscles targeted: Erector spinae, Abdominals Obliques
Technique: Sit up with knees bent and lean back at 45 degrees. Aim to hold a 'lengthened' spine, with lumbar spine in neutral, shoulders back and neck long and relaxed. It takes a fair



amount of control and strength endurance simply to hold this posture perfectly. Aim to get this right before progressing on to the catch and pass. Raise hands in front of your face and receive a pass from a partner, around this height. As you catch the ball you must hold the long spine position. Do not flex the low back, or become round-shouldered. Gently throw the ball back. Men should start with a 3kg ball; women with a 2kg ball. Complete a few passes, holding the position for 30 seconds. Perform2 to 3 sets.

Progression: Raising the hands to above head height makes the stability challenge of the catch significantly harder. Catches made to either side of the head are also more challenging.

Sit and Twist Pass

Overview: A trunk rotation exercise involving catching and passing the medicine ball, which provides a challenge to the obliques to produce powerful rotation, but also pelvic stability, so that the sitting position is stable throughout the movement.

Level: Advanced

Muscles targeted: Abdominals Obliques

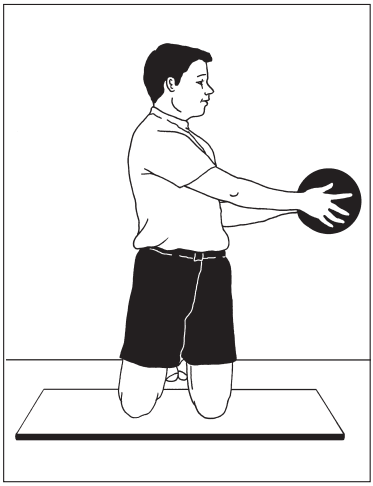
Technique: Sit up with knees bent and lean back at 45 degrees. Aim to hold a 'lengthened' spine, with lumbar spine in neutral, shoulders back and neck long and relaxed. Your feet, knees and hips should remain reasonably still throughout this exercise, the rotation coming from your waist and not your hips. Hold hands

to one side ready to receive the ball. Catch the ball to one side and absorb the catch by turning your shoulders further to that side. Reverse the rotation, turning back to the middle and release the ball. Continue rotating to the other side; receive the ball the other side and continue. Ensure you can hold good posture throughout the movement, with a long spine and wide shoulders. Men should start with a 4 to 5kg ball; women with a 2 to 3kg ball.

Perform10 to 20 reps.

Progression: Increase the weight of the ball once you can perform a set of 20 reps comfortably with perfect technique

Kneeling Twist Pass

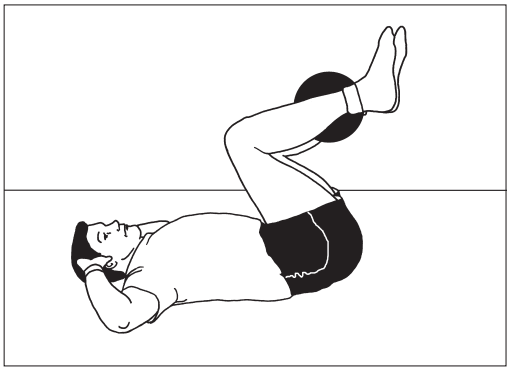


Overview: To perform the rotation movement in this position demands a greater range of motion, helping to develop strength through the full range of trunk rotation. It may also help to develop trunk rotation range of movement.

Level: Intermediate to advanced

Muscles targeted: Obliques

Technique: Kneel upright with good posture (lumbar spine in neutral, chest out, shoulders low). Start with the ball in hands and twist shoulders and head round as far as you can.



Then, under control, twist around to the other side as far as possible, and hand the ball to partner. Turn back to the start position, receive the ball again and continue. The aim of the movement is to rotate through the biggest shoulder turn you have. You can allow the hips to rotate a little with the shoulders, but not too much. You should feel a stretch in the side at the end of each twist. As you gain greater flexibility and stability you will be able to fix your pelvis square to the front and rotate through an increasingly full range of motion. Men should start with a 5 to 6kg ball; women with a 3 to 4kg ball. Perform 10 reps then take the ball to the opposite side and repeat.

Technique: Lie on back with hands behind head and elbows out to the sides. Knees should be bent and heels close to bum. Hold weight between your legs. Initiate the movement by curling the pelvis upwards (flattening the back into the floor) and then continue to use the abs to pull the low back and pelvis off the floor. This is the bit that requires good coordination, as the temptation is to kick with the legs and pull the hips up with the hip flexors. Learn to focus on the abs before you add weight, as if you do this strictly it is very tough, especially for women (whose pelvises are relatively heavier). Perform 5 to 10 reps; 2 to 3 sets.

Progression: Increase weight, maintaining the range of 5 to 10 reps per set.

Raphael Brandon

Notes

Notes